INCREASING THE EFFECTIVENESS OF CORPS FIRE SUPPORT THROUGH A TOTAL SYSTEMS APPROACH TO THE DESIGN AND IMPLEMENTATION OF A FIRE-DECISION SUPPORT SYSTEM

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by

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components and expected future developments of the corps fire support process are presented. Next, a total systems approach is utilized to delineate key problems and to propose viable solutions. Recommendations are made which should facilitate implementation of beneficial changes in corps fire support developmental and operational processes.

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TABLE OF ACRONYMS AND ABBREVIATIONS

ADE	-	Air Defense Element
ADP	-	Automatic Data Processing
AFMCO	-	Army Force Modernization Coordination Office
ALFI	-	Air-Land Forces Interface
ALO	-	Air Liaison Officer
AMIM	-	Army Modernization Information Memorandum
ASAC	-	All-Source Analysis Center
ASAS	-	All-Source Analysis System
AVN	-	Aviation
BCC	-	Battle Coordination Center
BDA	-	Battlefield Damage Assessment
BDP	-	Battlefield Development Plan
BETA	-	Battlefield Exploitation and Target Acquisition
CAA	-	Combined Arms Army
CACDA	-	U.S. Army Combined Developments Activity
CAME	-	Corps Airspace Management Element
CAS	-	Close Air Support
CBRE	-	Chemical, Biological, Radiological Element
CCC	-	Corps Computer Center
C-E	-	Communications-Electronics
CEWI	-	Combat Electronics Warfare Intelligence
C^3I	-	Command, Control, Communications and Intelligence
COSCOM	-	Corps Support Command
CTOC	-	Corps Tactical Operations Center
CTOS	-	Corps Tactical Operations System
D+4	-	Fourth Day After Deployment Day
DARCOM	-	U.S. Army Material Development and Readiness Command
DASC	-	Direct Air Support Center
DSS	-	Decision Support System
DTOS	-	Division Tactical Operations System
ENGR	-	Engineer
FA	-	Field Artillery
FAS	-	Field Artillery Section
FDSS	-	Fire Decision Support System
FEBA	-	Forward Edge of the Battle Area
FIST	-	Fire Support Team (Forward Observer)
FSCC	-	Fire Support Coordination Center
FSCOORD	-	Fire Support Coordinator
FSE	-	Fire Support Element
G-1	-	General Staff, Personnel
G-2	-	General Staff, Intelligence
G-3	-	General Staff, Operations
G-4	-	General Staff, Logistics
G-5	-	General Staff, Civil-Military Operations
GNP	-	Gross National Product

GSRS	-	General Support Rocket System
HHC	-	Headquarters-Headquarters Company
ICM	-	Improved Conventional Munition
IOD	-	Input-Output Device
MAIN CP	-	Main Command Post
MIS	-	Management Information Systems
MOE	-	Measure of Effectiveness
NATO	-	North Atlantic Treaty Organization
NGF	-	Naval Gun Fire
OD	-	Organizational Development
OE	-	Organizational Effectiveness
OPMS	-	Officer Personnel Management System
OV-I	-	Type of army aircraft used for reconnaissance and surveillance
PPBS	-	Planning, Programming, Budgeting System
RDT & E	-	Research, Development, Testing and Evaluation
ROK	-	Republic of Korea
SCORES	-	Scenario Oriented Recurring Evaluation System
SEAD	-	Suppression of Enemy Air Defense
SOP	-	Standard Operating Procedure
TACAIR	-	Tactical Air Support
TACFIRE	-	Tactical Fire Direction System
TCU	-	Terminal Control Unit
TOS	-	Tactical Operations System
TRADOC	-	U.S. Army Training and Doctrine Command

I. INTRODUCTION

> Shortly after 0400 hours on Sunday, 4 August (1985), it became clear to the Supreme Allied Commander in Europe, and was at once made known throughout a world waiting in an agony of suspense, that the Warsaw Pact had opened a general offensive against the forces of the Atlantic Alliance. The invasion of Western Europe had begun.
>
> General Sir John Hackett
> THE THIRD WORLD WAR, AUGUST 1985

While the above incident is fictitious, it accurately depicts the major concern of the NATO forces in Western Europe. Since the end of the Vietnam War, the U.S. has turned toward this threat and made the defense of Europe its first priority. As such, the European scenario presents a very dismal picture. Although force ratio estimates of Warsaw Pact forces versus NATO forces vary, an alarming ratio of, at least, two-to-one is an established fact. To add to this numerical advantage, the Soviet Union has in recent years spent a significantly high proportion of their GNP in modernizing their weapons and associated military equipment. Consequently, many observers believe that the Warsaw Pact is qualitatively, as well as quantitatively, superior to NATO forces.

Until recently, qualitative improvements to the Soviet forces have not been officially acknowledged by U.S. military or civilian leaders. Instead, the consensus indicated unwavering faith in the supremacy of American

technology, tactics and the spirit of the fighting man which could overcome any quantitative advantage the Soviets might possess. A recent estimate by Dr. Percy A. Pierre, Assistant Secretary of the Army for Research, Development and Acquisition, has indicated that "today the U.S. Army is inferior in virtually every major category of equipment and weapons required to wage and win wars" [Ref 1, p. 30]. If this is true, the security of the U.S. and the free world is categorically endangered.

This thesis was not written to debate this issue. Instead, it examined ongoing U.S. Army research, development and acquisition efforts in the area of corps fire support, evaluated their sufficiency, and suggests possible improvements. Key in this analysis was the careful identification of the factors which have prevented advanced U.S. technological capabilities from enhancing U.S. military operational capabilities. The existence of this problem area has openly been acknowledged. During a recent management review by the U.S. Army Material Development and Readiness Command (DARCOM), it was revealed that at least fifty percent of intensively managed items were behind production schedule. In most of these cases, the schedules had been previously extended. The final result has often been the development of systems incorporating technology eight to twelve years old. General John R. Guthrie, DARCOM commander, has described the situation as a "crisis of caring", faulting both the Army and American industry [Ref 2, p. 31].

Technological improvements may be considered in two basic categories. The first category could contain new equipment and weaponry, such as new tanks, aircraft, fighting vehicles and artillery. Detailed analysis of this category would be far beyond the scope of this thesis. This first category was dealt with, however, as it related to the second category composed of C^3I-type systems (Command, Control, Communications and Intelligence). In particular, this area has been intimately connected to the revolutionary automatic data-processing (ADP) technology which has characterized this past decade. Manifested by such innovations as mini-computers, computer graphics and light pens, the capability to process vast amounts of information swiftly and accurately could be invaluable on the modern battlefield. It is through the refinement and interpretation of this information that commanders will be able to allocate their combat resources to achieve a more favorable combat ratio at the decisive time and place in battle. In general, combat ratios consider effective firepower, both direct and indirect. Since direct firepower such as tanks, infantry weapons and the like are engaged at the lower echelons of command, it is not usually feasible to reallocate their effects in the short-term. Thus, indirect firepower in the form of long-range cannon, rocket and missile artillery becomes increasingly important in determining battle outcome. In addition, combat power from tactical aircraft and naval gunfire assets, if available,

can also be utilized to support the attainment of army force objectives. In the current army organizational hierarchy, the place where these types of firepower are allocated is at the army corps. This organization and its proposed technological improvements will be analyzed in this thesis.

Chapter II serves as the foundation from which the analysis of this thesis is built. Briefly, it examines the current army corps headquarters and its fire support process. From this base level of understanding, Chapter III proceeds to overlay the existing structure with the technological advances expected to be developed to augment the corps fire support mechanism. Thus, these two chapters are designed to work, in effect, in tandem in explaining the situation studied.

Chapter IV critically analyzes the problems or obstructions which have impeded the development of an effective decision support system for corps fire support. Chapter V proposes possible solutions to the problems presented in the previous chapter and is, therefore, the mainstay of this work. Chapter VI includes general conclusions derived from this analysis and recommendations intended to outline some of the actions needed to enhance corps fire support. It attempts to answer the perplexing question, which probably exists in many large organizations, of how to solve identified problems.

The methodology utilized in this analysis could be best categorized as a multi-disciplined approach. Indeed, the

complexity and dynamism of the corps fire support enigma has indicated that a single organizational, or procedural, oriented theory will not suffice. Thus, fields such as management theory, operations research, systems analysis, public policy and information theory have been drawn upon, where applicable. As might be predicted, the recommended methodology to resolve the corps fire support enigma is also based on a multi-disciplined, or "total systems," approach.

It is acknowledged that resolution of the corps fire support enigma will not, by itself, insure that the U.S. military community will succeed in meeting the Soviet threat. Indeed, this is representative of the uncertainties which characteristically accompany a hostile, combat environment. It is hoped that through an intensified effort to understand and resolve the intricacies of corps fire support, insight will be obtained that will assist in the development of additional methodologies that will enhance military effectiveness and, hence, national security.

II. CURRENT BASIS FOR CORPS FIRE SUPPORT MANAGEMENT

The U.S. Army maintains four complete, active-army, corps headquarters. These are the XVIII Airborne Corps, located at Fort Bragg, North Carolina; III Corps, located at Fort Hood, Texas; and V Corps and VII Corps, both located in the Federal Republic of Germany. Additionally, U.S. forces share the command of a fifth corps in the form of a combined Republic of Korea-U.S. Corps headquarters called the I Corps (ROK/U.S.) Group. An army corps is commanded by a Lieutenant-General (three star), and consists of a headquarters, three to five maneuver divisions, an organic corps support command (COSCOM) and additional units as its mission demands. This flexibility in composition allows this organization to be tailored to the various worldwide contingency plans which U.S. forces must be prepared to implement. A typical corps in the European scenario might be configured as shown in Table I.

Additionally, an army corps is given an apportionment of the Tactical Air Force (TACAIR) assets in the theater of operation in the form of TACAIR Close Air Support (CAS) Sorties [Ref 3, p. 3-1] . Through careful allocation and coordination of the air and artillery (retained under corps control) firepower, the corps commander attempts to influence the outcome of the battle. To facilitate the understanding of this process, this chapter explains how a corps

TABLE I

Illustrative Corps Composition

1. Headquarters (Corps Staff)

2. Divisions*:
   Two Armored Divisions
   One Mechanized Infantry Division
   One Infantry Division

3. Field Artillery Brigade:
   Two 155mm Howitzer, self-propelled, Battalions
   Two 8inch Howitzer, self-propelled, Battalions
   One 175mm Gun, self-propelled, Battalion
   Two Lance Missile Battalions

4. Armored Cavalry Regiment*

5. Army Aviation Group

6. Mechanized Infantry Brigade (Separate)*

7. Air Defense Group

8. Corps Support Command - consists of administrative and logistical support units.

9. Engineer Brigade

10. Signal Group

11. Military Police Group

12. Combat Electronic Warfare Intelligence Group (CEWI)

Note: Organizations annotated (*) have their own organic combat arms, combat support and combat service support elements to facilitate their designated mission. For example, they possess units such as artillery battalions, engineer, signal, and so on.

headquarters is tactically organized, the conceptual/ doctrinal basis for its employment, and the state-of-the-art weaponry available.

A. ORGANIZATION

The field location of the corps headquarters is referred to as the corps main command post (MAIN CP). Its physical configuration is called the Corps Tactical Operations Center (CTOC). As described in Department of the Army Field Manual 101-5, the CTOC is a "command installation in which communication facilities and personnel are centralized to control and coordinate tactical operations" [Ref 4, p. J-1]. Key in the successful functioning of this organization is the integration of land and air-based combat power into the commander's concept of operations. Continuous operational decisions and long-range planning further characterize this process.

The physical setup of the CTOC will vary considerably among different Corps, based on the type of equipment authorized. In the European Corps, for example, five-ton expansible vans are utilized to contain the various staff elements. In the Airborne Corps, light-weight tents with the capability of being interconnected are utilized. In addition, the CTOC could be established in a building, or group of buildings, such as those found in small towns throughout Europe.

Regardless of physical variations, CTOCs are functionally similar. Figure 1 depicts a typical functional layout of the CTOC at a MAIN CP location. The staff elements shown are identified in the Table of Acronyms. Those sections directly involved in the fire support allocation process are described in more detail in Table II.

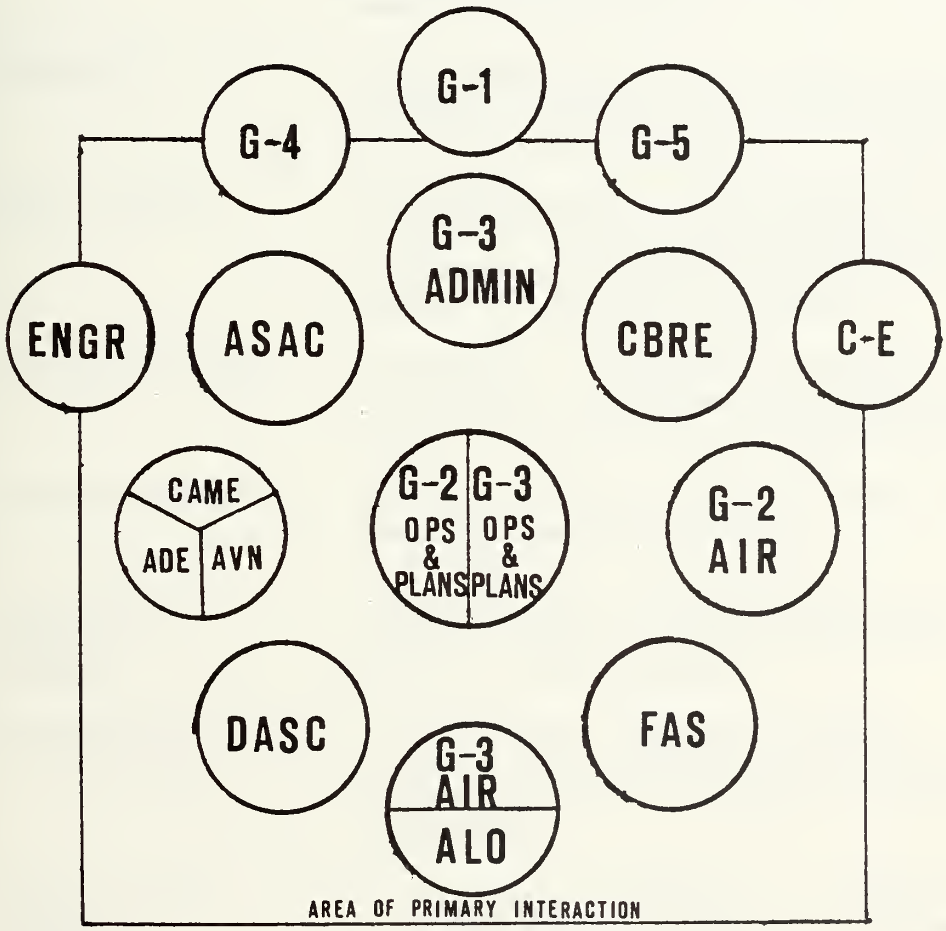

Figure 1. CTOC Functional Layout (MAIN CP)

TABLE II

Summary of Fire Support CTOC Elements

Element	Primary Fire Support Function
FAS, Field Artillery Section	Plan and coordinate the total fire support effort on surface targets for the Corps and provide tactical control of corps field artillery units retained directly under corps. Plans for conventional and nuclear weapons employment.
G-3, Operations	Supervises and coordinates overall tactical operations, both current (G-3 OPS) and future (G-3 Plans).
G-2, Intelligence	Coordinates all intelligence gathering activities and disseminates data to other staff elements and subordinate echelons of command.
G-3, Air Operations	Recommends employment of CAS resources. Insures integration of CAS with the ground tactical plan.
G-2, Air Intelligence	Directs the air surveillance and reconnaissance effort.
ASAC, All Source Analysis Center	Uses special intelligence sources to develop target intelligence and combat intelligence.
ALO, Air Liaison Officer	An Air Force officer working (physically) next to the FAS. Advises corps commander on TACAIR resources.
DASC, Direct Air Support Center	An Air Force facility - provides a quick-reaction capability to satisfy immediate requests for tactical air support. Located near the CTOC.
CBRE, Chemical, Biological Radiological, Element	Evaluates impact of friendly and enemy chemical or nuclear employment on the corps plan of operation.

The corps Chief of Staff, a Brigadier-General (one-star) position, is responsible for overall CTOC coordination and accomplishment of the staff assigned responsibilities. The physical layout of the CTOC and intra-staff work-flow are within his purview. He is assisted in these tasks by the Corps G-3 (operations) who has overall staff responsibility to coordinate and integrate available combat support with the tactical operations. The next section describes the conceptual environment within which the CTOC functions.

B. CONCEPTS/DOCTRINE

The piecemeal construction of this section reflects the veritable state of the subject matter. There does not exist a detailed, written document which adequately delineates the complex area of corps fire support. The closest approximation to this desirable entity is Department of the Army Field Manual 6-20, Fire Support in Combined Arms Operations [Ref 5]. This manual does cover the general subject matter; and division level, and below, fire support. It fails at the corps level, however, for reasons which will be explained in Chapter IV. The following subsections are not meant to encompass all of the concepts or doctrine that necessarily could apply to corps fire support. They do, however, briefly describe the primary conceptual issues pertaining to corps fire support.

1. Principles of War

The so-called, principles of war are considered by

most military men to capture the essence of military wisdom. In very general terms, they are guidelines for achieving success on the battlefield which have been established over years of trial and error. These principles of war [Ref 6, p. 2] are usually not explicitly connected with fire support, per se. However, they are clearly relevant and, therefore, are listed in Table III.

2. Fire Support Planning Versus Fire Support Coordination

Fire support planning is "the continuous and concurrent process of analyzing, allocating, and scheduling fire support and integrating it with maneuver to optimize combat power. Fire support coordination is the continuing process of implementing fire support planning and managing the fire support assets that support maneuver forces" [Ref 5, p. 3-5]. Stated another way, fire support planning is the written or verbal expression of how fire support is proposed to be employed versus fire support coordination which is the real-time, actions that result in firepower on a designated target on the battlefield. Table IV contains the basic principles of fire support coordination [Ref 7, p. 31] which the Field Artillery Section in the CTOC should consider in the allocation of fires. Figure 2 shows the corps fire support process. It intentionally emphasizes the centrality of the FAS and the intricacy of the process.

TABLE III

Principles of War

Principle	Definition
1. The Objective	Direct all efforts towards a decisive obtainable goal.
2. The Offensive	Seize, retain and exploit the initiative.
3. Unity of Command	For every mission there should be unity of effort under one responsible commander.
4. Mass	Achieve superiority in combat power at the decisive place and time.
5. Economy of Force	Allocate the minimum essential combat power to secondary efforts.
6. Maneuver	Position your military resources to insure the accomplishment of your mission.
7. Surprise	Accomplish your purpose before your enemy can react effectively.
8. Security	Never permit the enemy to acquire an unexpected advantage.
9. Simplicity	Prepare uncomplicated plans and concise orders to insure thorough understanding and execution.

TABLE IV

Principles of Fire Support Coordination

1. Consider the use of all fire support available. The capabilities and limitations of each type of fire support means must be considered to determine the most appropriate and effective means available.

2. Provide rapid coordination. Procedures must be established and practiced to effect rapid coordination and to attack targets within the shortest possible time.

3. Use the lowest echelon capable of furnishing effective support. Targets should be passed to the lowest echelons that have the means to engage them. If targets passed to the Corps FAS are in a divisional zone of action, the target should be sent to the division Fire Support Element.

4. Avoid unnecessary duplication. Fire support resources should not be wasted by the "overkilling" of targets.

5. Coordination at all echelons. The utilization of fire support means at all levels must be efficiently coordinated to insure fire support assets are optimized

6. Coordinate airspace. Cannon and missile firing trajectories must be identified to Army aircraft and CAS aircraft to insure friendly aircraft are not endangered.

7. Provide safeguards to friendly units. Positive measures must be implemented to insure friendly forces are not accidentally fired on or mistakenly engaged as a "hostile" target.

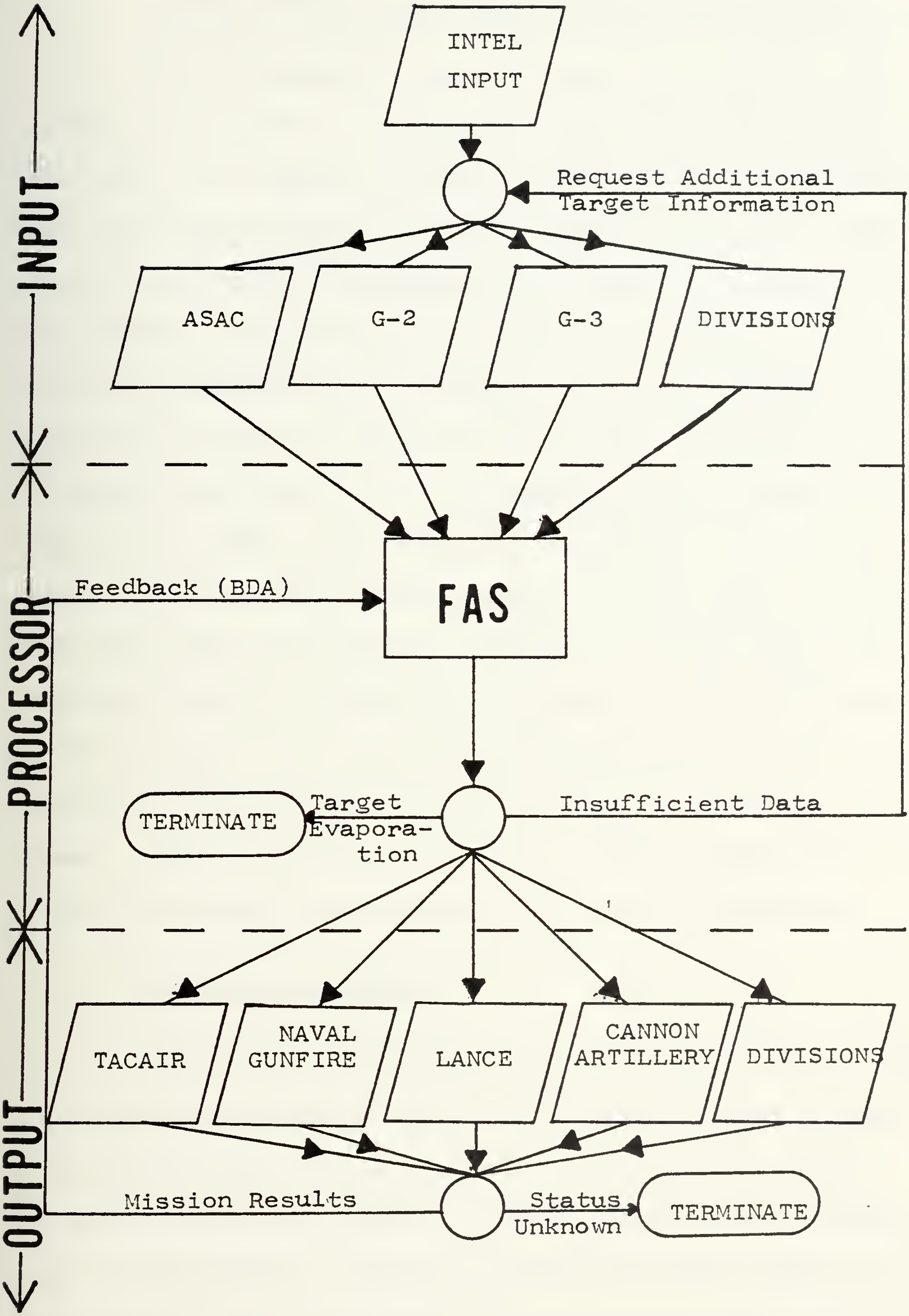

Figure 2. Corps Fire Support Process

3. Target Intelligence Versus Combat Intelligence

The distinction between target intelligence and combat intelligence is one of the most important concepts in the corps fire support process. Unfortunately, it is also the most misunderstood concept. Combat or tactical intelligence is general knowledge of the enemy, the weather and the geographical terrain. It aids the commander in the planning and execution of combat operations. Target intelligence is detailed, accurate and timely knowledge of the location, size and mobility of <u>specific</u> enemy combat, combat support or combat service support units [Ref 8, p. 3-32]. Target intelligence, understandably, is much more difficult to obtain than the general knowledge of enemy dispositions which is sought in combat intelligence. The salient point is that target intelligence, not combat intelligence, is required to effectively utilize firepower to engage the enemy. Thus, the FAS must receive target intelligence if corps fire support assets are to be adroitly employed.

4. Counterfire Concept

The counterfire concept evolved in the 1976-77 timeframe and unmistakenly precipitated several major changes in corps fire support structure and doctrine. The overall concept is that the attack of enemy indirect fire systems, called counterfire, should be transferred from corps level to division level, and below. The rationale was based on a study sponsored by the Army Training and Doctrine Command

(TRADOC) on the Central European battle scenario (Central Battle). Initial feedback from SCORES (Scenario Oriented Recurring Evaluation System) indicated that normally corps-retained, field artillery cannon assets should be transferred to subordinate divisions. Increased corps frontages, over-extended communications and increased density of targets during the early stages (through "D+4" days) of combat, supported the argument that the preponderance of combat power be within the immediate grasp of division commanders, who would fight the battle. This concept and the Nunn Amendment led to the deactivation of all corps artillery Headquarters and Headquarters batteries (199 personnel) which were traditionally part of the corps level units. In its place, the FAS (47 personnel) was formed and made a part of the Corps Headquarters and Headquarters Company (HHC).

5. Battlefield Interdiction

In the two year interim since counterfire was conceived, the Army has done a partial turn-around in its design of the doctrine for corps fire support. When SCORES Europe I, Sequence 2A, and the Europe Short-Warning Scenarios were performed, it was discovered that post D+4 operations reestablished the need for Corps level control of firepower assets. In particular, corps will execute battlefield interdiction with long-range firepower such as TACAIR and Lance missile fires. Battlefield Interdiction intends to engage enemy second echelon forces not yet in battle. The

theory underlying this concept is that Battlefield Interdiction will degrade the combat momentum of the threat and effectively prevent the second echelon forces from becoming a first echelon problem [Ref 9, p. 3].

C. CURRENT WEAPONS AND TECHNOLOGY

As Figure 2 depicts, corps fire support could be considered as having three major components: input, processor, and output. With that logic, this section lists major equipment and technology, comprising current corps fire support.

1. Input Category

The corps fire support decision process is nourished by several intelligence collection agencies. The bulk of target intelligence is obtained from the corps G-2 and the All-Source Analysis Center (ASAC). These agencies collect and process classified intelligence data from a variety of sources, such as national level assets, the corps CEWI group, the Air Force Direct Air Support Center (DASC), and intelligence passed from the subordinate divisions. This data is derived from three general types of surveillance systems. These systems monitor the enemy through sophisticated electronic sensors, detecting radio communications; imagery sensors, such as photographic equipment mounted on overhead aircraft and satellites; and human observation means, such as clandestine agents located behind enemy lines. Each of these area are composed of many types of

subsystems. For example, imagery intelligence gained through employment of the OV-1, fixed-wing, aircraft could include radar, infrared and high-resolution photographic sensors. At corps level, these types of intelligence must be collated. Target intelligence must be extracted in a timely fashion and passed to the Field Artillery Section for fire support processing.

2. Processing Category

The FAS, as previously stated, is the focal point for the corps fire support effort for the corps for both nuclear and conventional weaponry. It also provides tactical control for those field artillery units retained directly under corps. The exact composition and functioning of the FAS has not been totally agreed upon by the Field Artillery Center and School, located at Fort Sill, Oklahoma; and the active-army, corps organizations. The current (June 1979) proposed organization is found in Draft Field Manual 6-20-2. The reason for this discord is that the FAS organization is relatively new. FAS is a 47-person staff section which was first authorized worldwide in the 1978-79 timeframe. Prior to the FAS authorization, the fire support coordination center (FSCC) at corps level was called the Fire Support Element (FSE), a 19-person section.

The FAS, though larger, is not appreciably different than the FSE in terms of its basic functions. Thus, it must

be emphasized that the FAS was not a revolutionary change to the intra-staff relationships existing in CTOC organizations. Yet, the FAS does have the potential to greatly enhance the timeliness, accuracy and efficiency of the corps fire support process. This potential will not be realized, however, unless it is properly designed and intensively managed.

Table V shows a FAS organization, originally designed in 1977 by this writer, which was subsequently field-tested and adopted by the XVIII Airborne Corps FAS at Fort Bragg, North Carolina. This FAS version consists of three elements, each functionally modified from the original concept and current draft versions. These elements are a Headquarters Element (HQ), a Fire Support/Operations Element (FSOE) and a Target Intelligence Element (TIE). As indicated in Table V, the FAS is headed by a Brigadier-General who is considered to be the Corps Commander's Fire Support Coordinator (FSCOORD). The FAS contains 17 commissioned officers and 30 enlisted men. The Headquarters Element provides the personal staff for the FSCOORD, as well as administrative and logistical personnel who specifically monitor the status of corps field artillery units. The FSOE performs the operational aspects of the fire support planning and coordination functions. The TIE, as the acronym indicates, links the FSOE with the intelligence-related corps staff elements. In fact, some of the TIE's

TABLE V

Field Artillery Section

HEADQUARTERS ELEMENT		
FA Officer/FSCOORD	-	Brigadier General
Deputy FA Officer	-	Colonel
Enlisted Aide	-	Senior Enlisted
Secretary-Steno	-	"
Chauffer	-	Junior Enlisted
Vehicle Driver	-	"

FIRE SUPPORT OPERATIONS ELEMENT		
Asst. FSCOORD	-	Lieutenant Colonel
FA Operations Officer	-	Major
Two Team Chiefs	-	Major
FA Logistics Officer	-	Major
Asst. FA OPS Officer	-	Captain
Four Target Analysts	-	Captain
Operations Sergeant	-	Senior Enlisted
Four Asst. OPS SGTs	-	"
Ammunition Supply SGT	-	"
Four Operations Sp.	-	Junior Enlisted
Two Clerk Typists	-	"
Senior Radio Operator	-	"
Two Radio Operators	-	"

TARGET INTELLIGENCE ELEMENT		
FA Intelligence Off.	-	Major
Target Acquisition Off	-	Major
FA Operations Off.	-	Captain
Two Asst. FA Intel Off	-	Captain
Intelligence SGT	-	Senior Enlisted
Two Tgt Acq/Intel SGTs	-	"
Two Tgt Acq/Intel Sp.	-	Junior Enlisted
Two Clerk Typists	-	"
Chief Surveyor	-	Senior Enlisted
Three Survey Computers	-	"

NOTE: Senior Enlisted means pay grades E6 to E9.
Junior Enlisted means pay grades E3 to E6

personnel are located with the ASAC and the G-2 sections to facilitate the dissemination of target intelligence. The remaining portion of the TIE must be collocated with the FSOE to insure a coordinated effort is achieved.

The FAS, as was the FSE, is composed of Field Artillery branch officers and enlisted men, working in twelve-hour shifts on a continuous, 24 hours per day basis. The equipment and methods currently used in the FAS to maintain the status of corps fire support assets and to allocated targets to the appropriate fire support means are essentially identical to those used in World War II. For example, maps with acetate overlays are used to depict the location of field artillery units and to indicate their range limitations. From manual equipment such as this, the FAS must decide how to best allocate their fire support assets. As will be covered in Chapter III, there are more sophisticated means being developed. The current state-of-the-art is, at best, marginally sufficient.

3. Output Category

As shown in Figure 2, there are several possible outputs among which the FAS must decide. Of those shown, only tactical air support (TACAIR) and artillery (Lance and cannon artillery) retained under corps control will be discussed in this section. Naval gunfire (NGF) will not be covered since it is only available in specialized circumstances and not anticipated in the European scenario.

Targets may be passed to subordinate divisions. Divisional fire support assets should be then allocated, if available.

a. Availability of TACAIR

The availability of TACAIR sorties depends upon time of day and delivery restrictions. For example, conditions such as night, low visibility weather and low survivability due to enemy air defenses may limit corps fire support assets to solely indirect fire, field artillery weapons. The possible combinations of aircraft and ordnance loads are so numerous that the selection of air assets to be used on a particular target has been reserved for the Air Force.

b. Availability of Artillery

Indirect fire support weapons, organic to field artillery battalions, are assigned to corps along with a number of field artillery (FA) brigade headquarters according to the mission needs of the corps. Table I showed a possible composition of a, corps-assigned, FA brigade. The primary purpose of FA brigades is to augment division fires and reduce the span of control over the artillery assets. The fire support available to the FAS depends on what assets are retained under corps control. Normally, the Corps Commander is advised by the Corps Fire Support Coordinator (FSCOORD) to allocate the firepower of the corps' cannon artillery battalions to the divisions. This can be accomplished by attaching the FA brigades to the divisions, or by giving them what is known as a standard tactical

mission of "reinforcing" the division artillery. Regardless of how this is done, the result is that corps retains the Lance missile battalions as their sole source of field artillery support. This is entirely logical in that current U.S. cannon artillery have maximum range capabilities which are well within division target acquisition range. Thus, cannon artillery support would, in most cases, be more responsive by closer association with the division level.

A Lance missile battalion has three missile firing batteries, each with two missile launchers. Thus, two Lance missile battalions would have a total of twelve launchers. The Lance missile is a long-range, all weather, day-night, nuclear or conventional, highly mobile, guided missile system. It can fire an improved conventional munition (ICM) warhead section on its missile main assemblage from 8 to 65 kilometers. Since Lance is normally employed at least 15 kilometers behind the forward edge of the battle area (FEBA), maximum effective range of Lance fires is approximately 50 kilometers. The ICM warhead carries 830 BLU-63 bomblets that are dispersed in flight over a large target area and are highly effective against soft targets and some hard targets. When authorized, Lance can also fire its nuclear warhead up to a distance of 110 kilometers [Ref 10].

III. PROPOSED MODIFICATIONS OF CORPS FIRE SUPPORT

As identified in Chapter I, the European threat has been firmly established as the primary scenario influencing U.S. military thinking. With this as the main justification, the Department of Defense budgetary request for FY 1980 included approximately $13.6 billion for research, development, test, and evaluation (RDT & E) and $35.4 billion for the procurement of weapon systems and other military equipment and supplies [Ref 11, p. 2]. This chapter extracts from the myriad of RDT & E expenditures; projects which relate to the corps fire support process. As will be evident, these relatively few projects are in various stages of the developmental process. Operational fielding of most of the equipment and systems is expected in the 1982-1989 timeframe. Additionally, salient tactical concepts and doctrine that have been, or appear to be, evolving will be briefly described. The format of this chapter intentionally parallels the structure of Chapter II. Thus, mental superimposition of the proposed modifications of corps fire support over the existing structure will be simplified.

A. ORGANIZATIONAL CHANGES

The current corps staff organization closely follows the original corps headquarters which was patterned after

General John J. Pershing's 1917 design of the General Staff of the American Expeditionary Forces during World War I [Ref 12, p. 382]. Incredibly, there is little evidence of any overall plans for review of the field version of the Corps Headquarters, the CTOC, to substantiate its organizational efficacy. This predicament can be largely credited to two circumstances. The first, as stated in the Department of the Army, Staff Officers Field Manual 101-5, is that the "organization and mission of the command, as well as the needs and the desires of the commander, will determine the organization and operation of a TOC" [Ref 4, p. 8-3]. Unfortunately, while some of the corps commanders institute minor changes in staff working relationships or emphasize particular areas, CTOC organizations are rarely extensively or, more importantly, permanently changed. The second condition existing is that staffs (G-1, G-2, G-3, G-4, FAS, etc.) at corps and division levels are primarily constituted by personnel from distinct army branches that logically parallel the functions of these sections. While this procedure makes perfect <u>functional sense</u>, it essentially limits the scope of changes to staff sections to branch-related perturbations. Table VI outlines this dependency. Thus, if organizational changes in the CTOC occur at all, they generally occur at the individual staff section level. Similarly, improvements in the corps fire support process are constrained.

Table VI

Staff-Branch Relationship

Section	Primary Branch Affiliation
G-1	Adjutant General's Corps
G-2	Military Intelligence
G-3	Infantry, Armor, Field Artillery
G-4	Quartermaster, Transportation, and Ordnance Corps
FAS	Field Artillery
ASAC	Military Intelligence
CBRE	Chemical Corps
ADE	Air Defense Artillery
C-E	Signal Corps

B. EVOLVING CONCEPTS

The magnitude of the number of theoretical concepts being developed is directly proportional to the number of military services and major staff agencies involved. A concerted effort named the Battlefield Development Plan (BDP) intends to provide a logical basis for technological developments in weaponry and C^3I systems [Ref 13, p. 30]. The army organization behind this effort is the U.S. Army Training and Doctrine Command, commonly referred to as "TRADOC". The correctness of these concepts will not be debated here. Indeed, it would be difficult to disprove their viability, if for no other reason, due to their general nature.

1. <u>Army Tactical C^3I Architectural Concept</u>

This concept serves as the architectural foundation for the Army's development of an integrated and synergistic C^3I system which will support their tactical forces. The stated background and purpose for this concept are stated below in Table VII [Ref 14, p. I-1].

Table VII

<u>Army Tactical C^3I Concept</u>

BACKGROUND	PURPOSE:
• RAPIDLY ADVANCING TECHNOLOGY • CONSTRAINED MONETARY RESOURCES/INFLATION • FUNCTIONAL INTERDEPENDENCY • SEGMENTED COMBAT DEVELOPMENTS PROPONENCY • CONSTRAINED MEDIA • EFFECTIVE MARRIAGE OF HARDWARE/SOFTWARE • LOGISTICS SUPPORT • COMBINED & JOINT OPERATIONS	• ESTABLISH SOUND ARCHITECTURAL GOAL • OUTLINE REQUIRED FUNCTIONAL CAPABILITIES FOR 1985 C^3I SYSTEM • SHOW RELATIONSHIP OF CURRENT PROJECTS TO OBJECTIVE SYSTEM • DEFINE DEVELOPMENTAL STEPS AND PROCESSES TO REACH OBJECTIVE SYSTEM • IDENTIFY GAPS IN CURRENT DEVELOPMENT EFFORTS • ESTABLISH MANAGEMENT REQUIREMENTS TO REACH ARCHITECTURAL GOALS

This dynamic concept is currently based on three key principles as listed below:

1. <u>The corps is the focal point.</u>

2. <u>Key information needed will be identified and made available to the commander.</u>

3. <u>The System must be designed to support the commander under all possible conditions.</u>

Three terms commonly utilized within the C^3I architecture are real time, fusion of information and correlation of information. Real time refers to processing data in a situation with sufficient speed to be able to make a decision that will affect the outcome of that situation.

Fusion is essentially defined as the bringing together and comparison of information to provide the commander a clear understanding of the battlefield. Correlation of information is the comparison of two or more inputs from a single information collector.

The C^3I concept, if properly managed, has the potential of significantly enhancing the combat capability of U.S. forces, especially at Corps level. BETA, TOS, ASAS, and TACFIRE are several of the ongoing developmental efforts which have resulted from the C^3I concept. These projects, explained later in this chapter, serve as the basis for implementation of the C^3I strategy at corps level.

2. Division '86

Division '86 is an ongoing, branch-coordinated study headed by the Combined Arms Center at Fort Leavenworth, Kansas. As the name implies, this effort primarily concentrates on division level. The branch centers and schools, as shown in Table X, are responsible for input in their respective fields of expertise. Perturbations in corps fire support have resulted from over-emphasis at division level. In terms of field artillery fire support, this has caused a shift in attention back to division level which is akin to the orientation that occurred during the development of the counterfire doctrine. Also, a concept called <u>target servicing</u> has been added to the list of responsibilities of the field artillery. Target Servicing

refers to a methodical, queuing-type, plan for distributing indirect fire support on to enemy maneuver formations and related targets in the main battle area. While battlefield interdiction defined in Chapter II is still recognized, it is not certain how effectively this can be done if the preponderance of fire support assets are shifted to division level.

3 Air-Land Forces Interface (ALFI)

The ALFI concept was initiated in July 1976, as a result of correspondence between the commanders of the Army's TRADOC and the Air Force's TAC (Tactical Air Command). The rationale was, and still is, that the survivability of the U.S. close air support aircraft against a modern enemy like the Warsaw Pact would be highly dependent upon the suppression of the enemy air defense (SEAD) capability. This suppression would be obtained by a concerted effort to target enemy air defense and, consequently, allocate firepower to suppress their effectiveness. This firepower would include a portion of the tactical air support, but primarily consist of indirect fire support such as field artillery. The advantage of utilizing indirect fire support assets is that they are invulnerable to the air defense threat that is being destroyed or neutralized. A SEAD effort is envisioned at division and corps levels. However, the overall SEAD plan would be developed and coordinated in the CTOC [Ref 16].

Thus, an obvious effect on the corps fire support process which SEAD will have will be to compete for fire support resources, already at a premium.

4. Target-Rich Environment

The target-rich environment concept basically holds that increases in target acquisition capabilities will innundate the fire support system with viable targets. This concept is more theoretical, than factual. Nevertheless, it is the primary assumption along with the overall desire to more efficiently manage friendly assets for expansion into the automated data processing (ADP) field. The view of the European battlefield seems to substantiate this concept because of the high number of potential enemy targets which comprise the Warsaw Pact forces. Nevertheless it must be realized that the mere existence of targets does not automatically mean they can be effectively engaged by existing fire support assets. Highly mobile targets, for example, are generally impervious to unobserved, indirect fire weapons which are fired at the locations of targets, detected at some prior point in time.

C. EXPECTED TECHNOLOGY-BASED DEVELOPMENTS

The rapid growth of technology in the last decade has led to a proliferation of research and development in weaponry and C^3 I systems that has been difficult, if not impossible, to coordinate. This condition has been coupled

with tremendous economic constraints and a constantly changing perception of the nature of the future battlefield. Hence, the absolute confidence that our nation is increasing its national security is becoming more difficult to maintain. A small portion of the research and developmental efforts has been directed at the army corps level.

Before proceeding to a description of these efforts, there are two perspectives which should be clearly understood concerning any expectations which might be inferred. The first is that research and developmental products should not be construed as synonymous with operational capabilities. General Guthrie, DARCOM commander, has emphasized that "sometimes the state-of-the-art is refined to the extent that systems are obtained that work only in the laboratory or are much too complex" [Ref 2, p. 31]. Secondly, under the planning, programming, budgeting system (PPBS), Congress must annually appropriate the monetary funding needed for the continuation of each of these efforts. Indeed some, or all, of these efforts which are described could be cancelled before the equipment is fully developed and fielded.

This section will briefly outline these areas of development, in terms of the input, processing and output components of the corps fire support process, shown in Figure 2. The input and processing categories primarily consists of so-called "executive systems" which produce usable information for the commander and his staff. The

output category primarily contains the weapon systems which will be used to attack enemy forces.

1. Input Category

a. BETA

The development of the input mechanisms for the fire support processors are being led by a joint-service, Department of Defense-Directed, test-bed known as Project BETA (Battlefield Exploitation and Target Acquisition). BETA is intended to minimize costs and schedule risks by consolidating existing hardware and software information-processing technology where possible, and by providing a common means to test computerized correlation and display of intelligence data. The primary objective is to use all types of intelligence sensors, including national satellite sensors, to permit direct targeting of enemy ground targets. The impetus for BETA resulted partly from a study conducted by the Surveys and Investigation Staff of the Appropriations Committee of the House of Representatives. This study concluded that "existing Army Intelligence systems were almost useless because they had inadequate coverage, were not survivable, did not fuse all source data, and were of inadequate accuracy to permit targeting by Army weapons systems" [Ref 15, p. 807].

BETA, as has been stated, is a test bed. It is therefore simply a means for experimentation to facilitate development of the actual tactical systems that will be

employed. BETA will be deployed to Europe in the fall of 1980 to be evaluated during the annual Reforger exercise. BETA will continue to be developed into 1981. Its proved functions will be incorporated into two other developmental efforts called the All Source Analysis System (ASAS) and the Tactical Operations System (TOS).

b. ASAS

ASAS is a computerized system being developed for corps and division levels which will result in acceptance, processing and analysis of both preprocessed and raw information from an array of intelligence sources. As the name ASAS might indicate, it will be utilized in the All Source Analysis Centers (See Figure 1 and Table II) located in the CTOC and the DTOC (Division Tactical Operations Center). At corps level, intelligence sources include Army, Joint, National and Allied systems. With current technological constraints, the ASAS will consist of two separate processors, one for collateral and one for special intelligence data. Collateral (noncompartmented) intelligence is essentially data obtained as a by-product of friendly and enemy units which are engaged in the battle. Thus, the probable source of the intelligence is, to some degree, common knowledge to both sides. Special intelligence or Sensitive Compartmented Information (SCI) is obtained from highly classified sources. The knowledge of even their very existence must be protected from the enemy. According to current national security regulations, intelligence

derived from these type sources must be <u>sanitized</u>, that is removal of any identification of source, before the data is processed for either targeting purposes or general knowledge of the enemy situation. The collateral processor will control the principal data base and interoperate with the TOS. When it is technologically possible, the ASAS system will consist of only one processor which will perform both functions.

c. TOS

Tactical Operations System (TOS) is a computerized command and control system for corps (CTOS) and division (DTOS) tactical operations centers. It is being developed at the U.S. Army Combined Developments Activity (CACDA) at Fort Leavenworth, Kansas. Its purpose is to give the tactical commander and his staff the means to evaluate and process the massive amount of intelligence, operational and logistical data expected from ADP technological advances. Key in the TOS design will be the extensive use of interactive graphic display devices. These user-oriented, devices hope to significantly improve real-time visualization and evaluation of the tactical situation. The CTOS will be electronically interfaced with lower, adjacent and higher headquarters. Figure 3 [Ref 17, p. B-7] depicts how CTOS is presently envisioned.

Figure 3 is based on a CTOC organization which has been proposed from the ALFI concept. Basically, the CTOC contains a battle coordination center (BCC), an

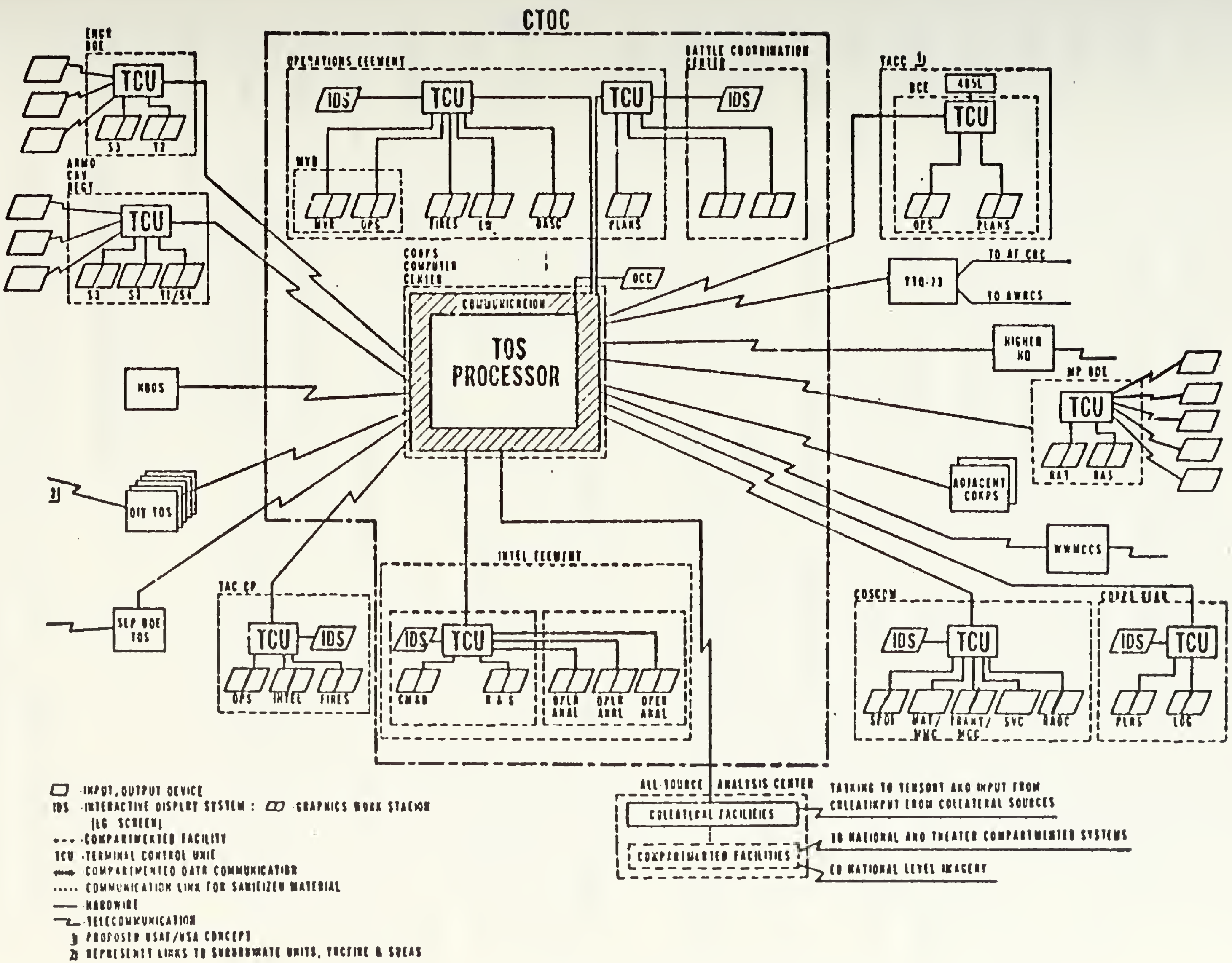

Figure 3. Corps TOS Configuration

intelligence element, and an operations element. The BCC is designed to contain the commander's equipment which will allow him to monitor the situation. The heart of the TOS will be the corps computer center (CCC) which will constitute the major computational capability within the corps. The CTOC will contain three terminal control units (TCU) which will be powerful, but small minicomputers. The TCU will provide the capability to receive, prompt, process, transmit, retrieve, compose, edit, validate, store, display, print, net monitor digital/voice messages, and interface with the standard Army tactical communications systems. Coupled to the TCU's are input-output devices (IOD) which will have a color graphic display, hardcopy output, memory capability and keyboard.

In the area of corps fire support, the Fires section will utilize its IOD to extract target intelligence from the CTOS for input into the Tactical Fire Direction System (TACFIRE). Essentially, the Fires section will be a derivation of the FAS organization, previously explained. In addition, the fires section will be able to monitor the current tactical situation displayed by CTOS and adjust fire support assets accordingly.

2. Processing Category

Since the mid-sixties, the U.S. Army and Litton Industries have been developing a large-scale, computer-based management information system called the Tactical Fire

Direction System (TACFIRE). The purpose of this system is to increase the effectiveness of the fire support of maneuver forces. This can be accomplished by improving field artillery command and control through a faster and more efficient use of target intelligence, nuclear and nonnuclear target analysis procedures, and the allocation of fire support resources. Figure 4 depicts the basic methodology of TACFIRE [Ref 18, p. 11].

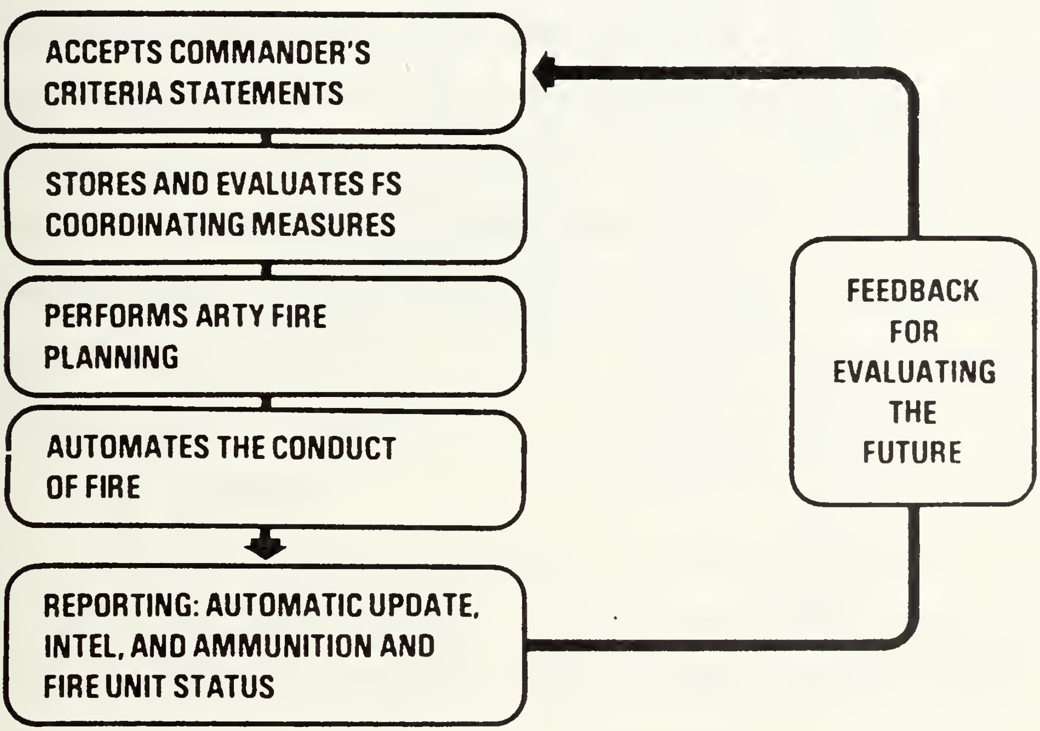

Figure 4. Basic TACFIRE Methodology

Essentially, TACFIRE intends to accomplish its mission by providing automatic data-processing speed and computerized digital communications to the field artillery system in lieu of manual computations and voice communications. TACFIRE, through division level has been tested in a field environment by the 1st Cavalry Division Artillery at Fort Hood, Texas in 1978. Results of this operational testing were favorable, and consequently, the U.S. Army has made the decision to purchase additional TACFIRE equipment to supply divisions worldwide.

TACFIRE is intended to employ fire support assets in a hierarchical manner through maneuver company, battalion, brigade, division and corps echelons of command. The development of the TACFIRE interface at corps level is currently ongoing. This development involves primarily software design, since the TACFIRE equipment (hardware) at corps level is identical in type, to the division artillery equipment which is currently in production.

a. Hardware

The TACFIRE equipment is shown in Figure 5 [Ref 18, p. B-2] and listed, by field artillery echelon, in Table VIII [Ref 18, p. B-6]. Essentially, TACFIRE represents third-generation computer technology. The majority of the equipment is transported by equipment shelters mounted on 5-ton trucks. Digital communications over standard army communications equipment enable the computers at division artillery and corps FAS to share/exchange data in "real time."

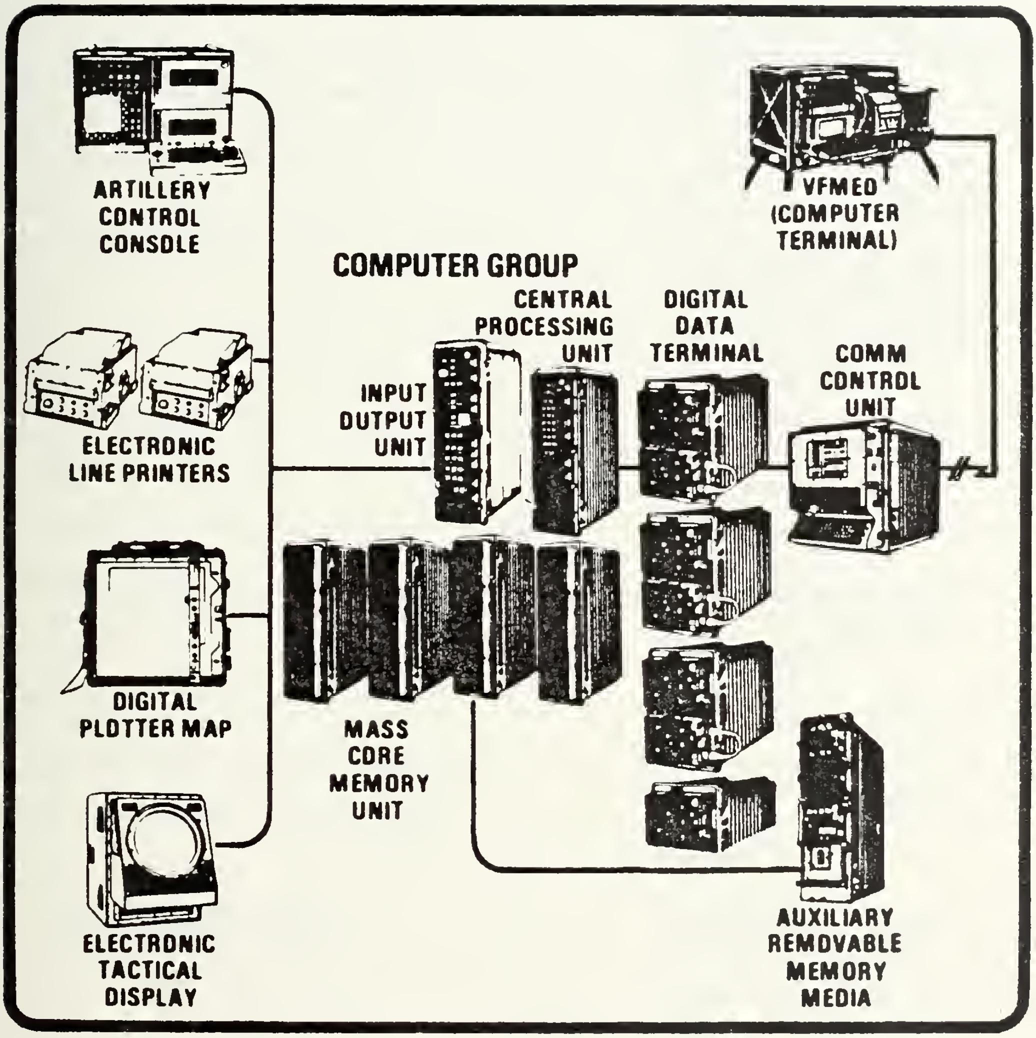

Figure 5. Pictorial display of TACFIRE hardware

TABLE VIII

TACFIRE Equipment at Field Artillery Levels

	EQUIPMENT	CORPS	DIVISION	PURPOSE
1.	Artillery Control Console(ACC)	1	1	Interfaces operator with the computer. Will control all processing, data entry, and data retrieval.
2.	Electronic Line Printer (ELP)	2	2	Provides a printout of each transaction.
3.	Digital Plotter Map (DPM)	1	1	Draws fire support coordination measures and target data on maps or overlays.
4.	Electronic Tactical Display (ETD)	1	1	Shows(on a cathode ray tube) fire support coordination measures and target data.
5.	Central Processing Unit (CPU)	1	1	Performs all data processing to generate solutions to FA problems.
6.	Input/Output Unit (IOU)	1	1	Controls data transfer between the computer's CPU, memories, and all other components.
7.	Mass Core Memory Units (MCMU)	4	4	Stores data and programs for use by the CPU.
8.	Auxiliary Removable Media Memory (ARMM) - magnetic tape	2	2	Enables loading of programs into the computer's memories and storage of dynamic data.
9.	Digital Data Terminal (DDT)	7	7	Connects the computer to Army communication devices.
10.	Communication Control Unit(CCU)	1	1	Provides automated control of all communications.
11.	Communication Security System	1	1	Enables the encryption and decryption of digital mes-messages.
12.	Variable Format Message Entry Device (VFMED)	2	2	An interactive computer terminal to be located in the FAS and Division FSE.
13.	S-280 Equipment Shelter	2	2	Houses the TACFIRE computer center hardware.

NOTE: TACFIRE equipment will also be found at the Field Artillery battalion level (not included above). All echelons will be electromagnetically linked, to provide near real-time interaction.

b. Software

The Amended Statement of Work [Ref 19] is the current (July 1979) basis for the software being developed for the TACFIRE hardware found at the Corps FAS. As stated in that document, the impetus behind the basic concept of design (BCD) is, "... to arrive at a common configuration, both software and hardware, that will support Division Artillery FA Brigade, and Corps FAS operations. The largest life-cycle-cost benefit from such an approach is the tremendous reduction in software maintenance and operator/maintenance personnel training" [Ref 19, p. 17]. Basically, this software is designed to consider, as desired, nuclear and nonnuclear munitions from all field artillery, naval gunfire, air and missile weapon systems available in the corps zone of fire. By using preprogrammed, deterministic effectiveness computations, TACFIRE will recommend the "best" weapon system available and compute the amount of munitions required to achieve a specified effectiveness level. Through the hardware interactive terminals, TACFIRE will accept user modifications to this criteria. In addition, TACFIRE will store and evaluate fire support coordination measures in the processing of target information. As figures 5 and Table VIII indicate, TACFIRE hardware is capable of displaying information in many forms. Current target lists, fire plans, unit status reports and ammunition status reports are continuously updated for "real time" evaluation of the tactical situation.

3. Output Category

Technological innovations characterize the proposed changes in corps fire support weapon systems. Typically, these innovations attempt to counter the rapidly moving armored vehicle, European-type threat via increases in weapon system effectiveness. Table IX summarizes these developments at corps level into three categories: cannon artillery munitions, the General Rocket System (GSRS) and the Assault Breaker Program [Ref 20].

TABLE IX

Developmental Output Summary

CATEGORY	NOMENCLATURE	BASIC DESCRIPTION	PRIMARY PURPOSE	MAXIMUM RANGE	OPERATING DATE
1. Cannon Artillery Munitions (for 155mm and 8 inch howitzers)	ICM-DP(Improved Conventional Munitions -Dual Purpose,M483A1)	Projectile which releases multiple submunitions over the target area, resulting in increased area coverage and weapon lethality. Dual purpose refers to the submunitions being both anti-personnel and anti-material(light armor). Has increased effectiveness over conventional high-explosive rounds. Submunitions detonate on ground/object contact.	Division Fire Support (Also for Corps FS to an extent)	15-18 KMS	Now
	FASCAM (Family of Scatterable Mines)	Two Basic Types: ADAM (Area Denial Artillery Munition,M692/731) and RAAM (Remote Antiarmor Mine System M718/741). Artillery projectiles are used to deliver mines over the target area.	Corps coordinated Interdiction	12-15 KMS	1982-84
	CLGP (Cannon Launched Guided Projectile,XM712)	A 155mm anti-armor projectile which is guided to the target by homing-in on reflected laser energy off the target. The target is laser "designated" by a forward observer (FIST). Makes first round, hit capability of armor possible.	Division Fire Support	14-16 KMS	1981-82
	RAP (Rocket Assisted Projectile,M549)	An artillery projectile with a rocket motor attached to the projectile base, which will extend the range capability of a normal,high-explosive, round 5 to 10 KMS. Currently slated for 155mm and 8 inch howitzers.	Same as ICM-DP, above	20-30 KMS	1981-82
2. General Support Rocket System	GSRS	An indirect,multiple rocket, rapid fire artillery launcher. Will fire up to 12 rockets simultaneously with ICM-type warheads. Currently, rockets are unguided, making GSRS an area-fire weapon. RDT&E funds have been requested for FY 1980 to develop terminally-guided warheads (TGW) for modification of GSRS to permit the individual attach of armored vehicles.	Corps Fire Support	30 KMS	1981-84 (Unguided Version)
3. Assault Breaker	a. Surface to Surface(F22) b. Air to Surface (WAAM)	Systems specifically designed for battlefield interdiction of the enemy's second echelon forces. Intends to integrate target acquisition assets with weapon systems containing terminally guided munitions, each of which engages a target.The Assault Breaker Program is centrally managed by the Defense Advance Research Projects Agency(DARPA	Corps Fire Support	Up to 150 KMS	1985-90

IV. THE CORPS FIRE SUPPORT ENIGMA

The corps fire support process, as evident from the preceding chapters, is enormously intricate. It clearly is a very complex system. As technological advances in C^3I systems and weaponry evolve, corps fire support also becomes increasingly complicated. A complete understanding of all parameters affecting corps fire support is essential to a viable design, development, and operation of the corps fire support system. However, before these parameters can be accurately identified to system developers, they must first be fully understood by the personnel in the CTOC. The extent to which these parameters are not understood or unknown is indicative of the magnitude of the corps fire support enigma. An enigma, or problem, may be defined as "a blocked managerial goal" [Ref 21, p. 28]. In the corps fire support process, the problem exists as how to maximize the effects of all fire support assets available to the corps in support of the specified mission.

A number of factors exist which impede the attainment of a viable corps fire support system. These factors will be described from three vantage points or perspectives. These perspectives provide a framework within which the complexity of the corps fire support process may be understood. They represent a continuum of existing deficiencies and not separate, distinct problem categories. This chapter will

view these factors contributing to the problem from systemic, organizational and operational perspectives. Chapter V will then provide possible measures to eliminate some of these factors in order that effective corps fire support may be obtained.

A. SYSTEMIC PERSPECTIVE

The systemic view concentrates on the organizations which are external to the corps headquarters and the CTOC configuration. Stated differently, these are specific factors caused by procedures and organizations above, and below, corps level which manifest themselves as obstructions to the development of effective corps fire support. These factors have been categorized into the four areas of discontinuity, situational uncertainty, relational conflict, and nonproductivity.

1. Discontinuity

Three distinct types of discontinuity have been identified by a recent study done for the Secretary of Defense by the Rice Committee [Ref 22] . The first type is discontinuity between the developing contractor, or agency, and the ultimate user. In corps fire support development, the major participants involved are DARCOM commands, TRADOC centers, Army branch centers and schools, civilian contractors and the corps headquarters (user) . Table X lists some of these participants involved with their primary

geographical locations. Although it is recognized that some of these participants establish field offices, or make periodic liaison visits, the fact remains that geographical dispersion creates intolerable coordination and communication problems. This has manifested itself in repeated instances where initially defined mission requirements and system design proposals radically change during the research, development and acquisition process. The final version of the system often falls short of operational expectations. Typically, this form of discontinuity is evidenced by cost overruns, delayed production schedules, and crisis-to-crisis management.

The second type of discontinuity "concerns the difficulties of simultaneously developing several major subsystems and integrating them into a weapon system" [Ref 22, p. 32]. This problem is patently applicable to the development of C^3I systems. When viewed as a broad spectrum of interrelated systems and subsystems, multiple technological applications create a formidable problem. Simply stated, there is no such thing as a corps fire-decision support system program; there is a series of projects concerned with corps fire support.

The last form of discontinuity results from personal or corporate objectives which conflict with a coherent, streamlined, acquisition or design effort. A program manager, for example, may seek short-term results which are personally or professionally beneficial but are detrimental

TABLE X

Geographical Discontinuity

MAJOR PARTICIPANTS	PRIMARY LOCATION
DARCOM:	
Armament Material Readiness Command	Rock Island, Ill.
Armament R&D Command	Dover, NJ
Aviation R&D Command	St. Louis, Mo
Communications & Electronics Material Readiness Cmd.	Ft. Monmouth, NJ
Communications R&D Command	"
Electronics R&D Command	Adelphi, Md
Missile Command	Huntsville, Ala
Mobility Equipment R&D Command	Ft. Belvoir, Va
Natick R&D Command	Natick, Mass
Tank-Automotive R&D Command	Warren, Mich
TRADOC:	
Combined Arms Center	Ft. Leavenworth, Kan
Logistics Center	Ft. Lee, Va
Combat Developments Experimentation Command	Ft. Ord, Calif
Combined Arms Combat Developments Agency	Ft. Leavenworth, Kan
Combined Arms Test Activity	Ft. Hood, Tex
SCHOOLS & CENTERS:	
Air Defense	Ft. Bliss, Tex
Armor	Ft. Knox, Ky
Army War College	Carlisle Barracks, Pa
Aviation	Ft. Rucker, Ala
Command & General Staff College	Ft. Leavenworth, Kan
Engineer	Ft. Belvoir, Va
Field Artillery	Ft. Sill, Oklahoma
Infantry	Ft. Benning, Ga
Intelligence	Ft. Huachuca, Ariz
Logistics Management Center	Ft. Lee, Va
Missile & Munitions	Redstone Arsenal, Ala
Ordnance & Chemical	Aberdeen Proving Gd, Md
Transportation	Ft. Eustis, Va
CORPS HEADQUARTERS:	
III Corps	Ft. Hood, Tex
V Corps	Germany
VII Corps	Germany
XVIII Airborne Corps	Ft. Bragg, NC
I Corps (ROK/U.S.) Group	Korea

to the overall developmental efforts. Likewise, corporate-type entities including commercial developers and defense agencies may be driven by profit or power motives. These types of objectives, while acceptable in the democratic framework of free enterprise, can be an encumbrance in the quest for military preparedness.

2. Situational Uncertainty

The army's primary objective is to "win the land battle" [Ref 23, p. 1-1]. While this generalized statement is applicable to all army echelons, it does not provide any insight into the various factors which decrease combat effectiveness due to constantly changing situational factors. As explained in Chapter II, corps organizations have geographical, structural, and physical equipment differences. Consequently, each corps organization has certain nuances which result in a significantly different set of situational requirements. In modern system development and design procedures, some of these differences are recognized and compensated. Yet, there are some differences which are not compensated due to three distinct reasons. The first, and most obvious, reason is that all nuances are not known or clearly understood by the developing agency. Secondly, those that are defined at one point in time, may be dependent upon a specific scenario, capability or tactic which is altered without subsequent altering of the requirement. The third possibility is that the requirement may be

known and understood, but not compensated because of major changes in equipment design which would result or an assumption that the user organization can resolve the inadequacy. These inadequacies generally are recognized by the user organizations only after the systems are fielded and used in several tactical field exercises. Then these deficiencies often result in the generation of additional requirements which demand that the research, development and acquisition process to continue, ad nauseam.

3. Relational Conflict

One fundamental principle commonly associated with a military organization is chain of command. This principle is based on a hierarchical relationship between senior and subordinate commanders. In the allocation of corps fire support means, a conflict often arises between the corps and division commanders. While the corps commander is organizationally senior to his division commanders, there exists at division and below levels, a strong belief that artillery assets available at corps should be attached to subordinate echelons. As written in an article shortly after World War II, "this is a natural and very human position, but one which is not soundly based" [Ref 24, p. 101]. The initial surge of the counterfire concept added temporary support to the rationale to control artillery firepower below corps level. As has been indicated, this rationale has been partially weakened within recent years

with the advent of Battlefield Interdiction. The danger that exists is that the relational conflict will obstruct or delay the shifting of corps fire support from the control of the divisions back to corps control in the post D+4 period. A means to resolve this relational conflict must be found.

4. Nonproductivity

In 1964, the House of Representatives' Military Operations Subcommittee criticized the Department of Defense's research and development philosophy as exhibiting "overmanagement and underperformance" [Ref 25, p. 13]. Although it is true that the services have complex systems with subtle problems, current evidence still indicates that this criticism is valid [Ref 2, p. 31]. Underperformance that can be correctly attributed to fiscal constraints may be somewhat justified. Underperformance due to inefficiencies, however, cannot be defended. The institution of the Planning, Programming and Budgeting System (PPBS) in recent years has attempted to rectify these types of deficiencies. Additionally, Congress has taken a much more active role in controlling the budgetary process as evidenced by the 1974 Congressional Budget and Impoundment Control Act [Ref 26, p. 81]. Ironically, it may even be asserted that PPBS and added congressional involvement has increased overmanagement or overcontrol of the research, development and acquisition process. Despite the validity of the original

rationale used to establish these mechanisms, the fact remains that corps fire support operational capabilities do not appear in concert with recognized technological advances.

B. ORGANIZATIONAL PERSPECTIVE

The corps headquarters organization and its CTOC configuration have certain intrinsic factors which impede the attainment of effective corps fire support. While some of the same characteristics are found at lower echelons, the ability at corps level to actively and expeditiously resolve resulting problems is less robust. This section identifies these factors as basic generic characteristics and as specific functional obstructions. The perspective utilized in this analysis equates to a view of the CTOC organization from top (Commander or Chief of Staff) and mid-level (Staff Section heads) managerial positions.

1. <u>Generic Characteristics</u>

a. Garrison versus Field Conditions

U.S. active-army units fluctuate between two, distinctively different, environmental settings. The majority of the time is spent in a garrison setting with emphasis on maintenance of equipment, classroom training and administrative duties. Corps headquarters are generally maintained close to one hundred percent of the authorized

number of personnel. Despite this apparent indicator of well-being, it is not uncommon for headquarters to operate, during garrison conditions, under fourteen-hour workdays. Garrison operations revolve around fixed, corporate-type, organizational relationships and non-combat functions. Thus, the fire support process as found in the CTOC is not exercised in the garrison setting.

During field exercises, the corps headquarters deploys in the CTOC configuration. Although it varies with each corps, it is an infrequent occurrence. Over the span of a year, corps headquarters deploy only three or four times for seven to ten day exercises. The effectiveness of these exercises as a training device depends upon the extent to which subordinate and adjacent headquarters are concurrently deployed during the exercises and the magnitude of the functional obstructions, which will be described later. This observation particularly holds true for the fire support process. Rarely, if ever, are all elements of the fire support system exercised jointly. Consequently, the readiness of major army headquarters to be immediately engaged in an intense combat environment is questionable.

In fairness to army leaders, fiscal and time scheduling constraints limit the number of field exercises that can be conducted. Nevertheless, there is not a constant refinement of the fire support process. New technological advances are merely superimposed on an, already, insufficient situation. Additionally, field

exercises do not fully simulate the reality of combat. Limited time in the field and the need to return to take care of garrison responsibilities causes field experience to be treated, in general, as a necessary evil as opposed to a critically needed expertise.

b. Proximity to Battle

In Management in the Armed Forces, written by British author J.C.T. Downey, the basic nature of an army is contrasted with the navy and air force services. Essentially, Downey maintains that the army is "an organization which must come to close quarters with its enemy and engage in fighting with plenty of short, sharp jabs to the body," while the navy and air force are not engaged with the enemy as whole organizations [Ref 27, p. 78]. As a general statement concerning division level and below, this perception is valid. It is invalid to extend this belief automatically to corps level, however. In wars with a relatively established Forward Edge of the Battle Area (FEBA) such as that envisioned in the European scenario, there is a physical basis for this rationale. Proximity of headquarters and tactical units to enemy forces increases their active engagement and the probability of receiving enemy fires. From company through division level, the inversely proportional relationship between distance from the enemy and intensity of involvement is relatively constant. Between division and corps level, however, the intensity of involvement is drastically decreased. This

disproportionally is primarily caused by the limited ability of the enemy's fire support systems to effectively engage targets at long ranges. Figure 6 graphically depicts the spatial relationship of corps (XXX) and division (XX) tactical operation centers (shown by the headquarters symbols) and the fire support coordination boundaries.

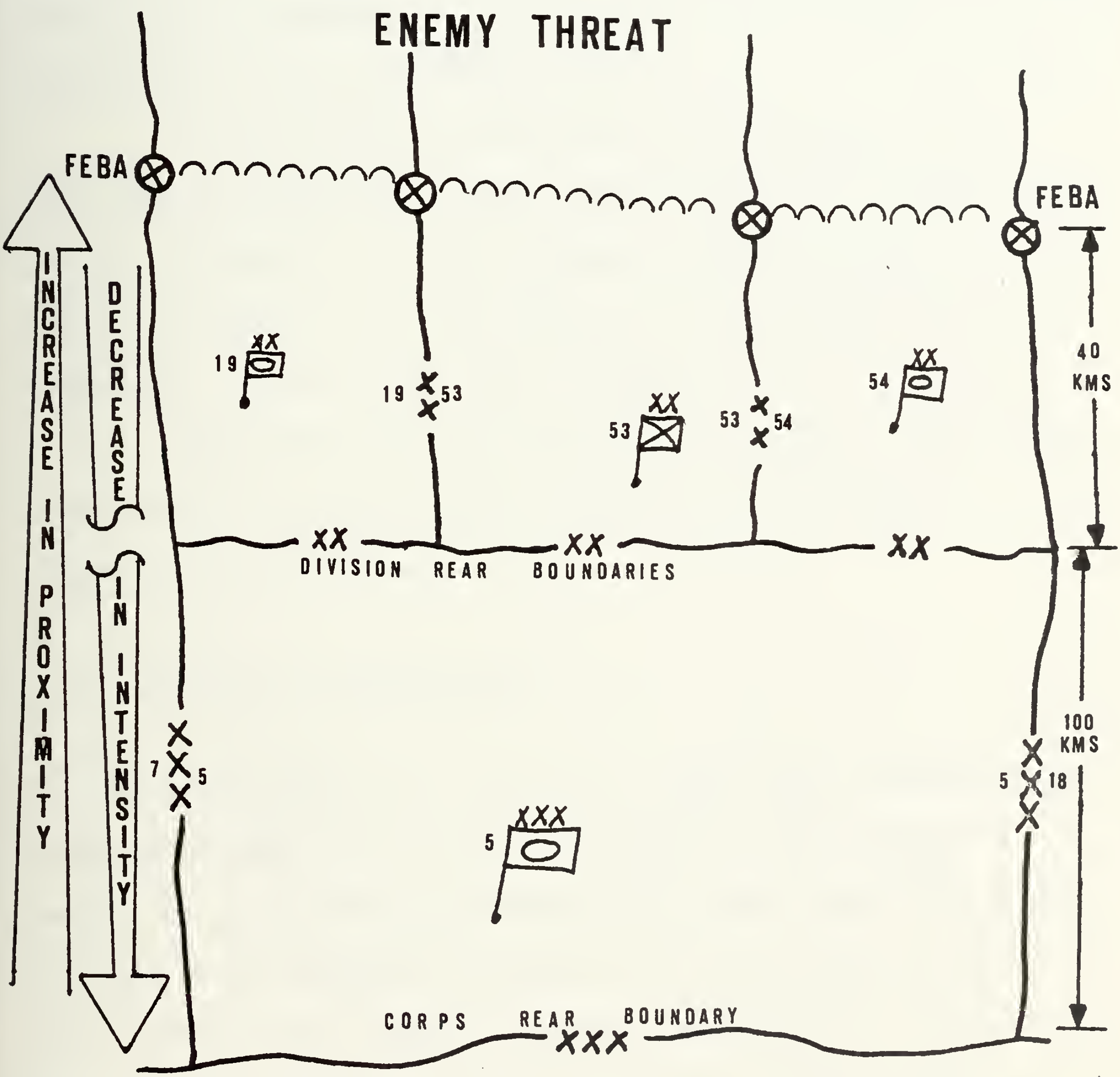

Figure 6. Situation Overlay

2. Functional Obstructions

Factors which result in a degradation of the fire support process can be considered as functional obstructions. Typically, these obstructions clearly violate one, or more, of the fire support coordination principles listed in Table IV. They are parochial to the corps tactical operation center environment. A listing of these factors will not be located in existing army field manuals or corps standing operating procedure (SOP).

Technological innovations, by themselves, are unlikely to eliminate these subtle barriers to organizational efficiency. Their design, development, and implementation will be fruitless if the organizational framework in which they will be employed is ineffectual.

Table XI lists the factors pertinent to the corps fire support process. With each factor is a brief description and explanation of its effect.

C. OPERATIONAL PERSPECTIVE

Hannibal (274 B.C. - 182 B.C.) has been credited with stating, "Regardless of its mechanisms, war remains a matter of human beings, directed by their minds" [Ref 27, p. 97]. This statement appears to be basically valid, even today in the light of modern technology. For this reason, the corps fire support process must be also examined from the individual staff officer, or operator,

Table XI

Functional Obstructions to Corps Fire Support

1. Lack of Common Knowledge: The fire support process is so complex that it is difficult for all staff sections and their personnel to fully understand all the parameters. While the FAS personnel are in the best position to understand the process, they cannot compensate for failures in other sections.

2. Lack of a Common Sense of Urgency: A responsive fire support process requires a deep appreciation of the element of time. The accomplishment of long-range planning must be tempered by the reality of current operations. A sense of urgency is a relative concept which must be evenly distributed throughout the CTOC.

3. Section Autonomy: This factor might be equally called-unshared goals. Despite the logic of unity of purpose, the impetus for staff sections to work towards the common goal of a viable fire support system is conspicuously absent in peacetime. This holds particularly for garrison configurations but extends over into the limited number of field exercises.

4. Branch/Section Mystique: As Table VI depicts, staff sections are composed of soldiers with particular branch backgrounds. During current operations, staff sections may fail to interface properly with other sections due to a basic lack of understanding of the requirements or their capabilities.

5. Environmental Inconsistency: CTOCs are physically constructed according to the types of equipment and staff sections authorized and present. The necessity to move this complex according to the tactical situation poses different problems every time it is done. Communications equipment, map boards, charts, work areas and the spatial arrangement of the staff sections can, and do, change and can affect the efficiency of the fire support process. To the fullest extent possible, each CTOC has SOPs designed to lessen the turmoil. Nevertheless, the fire support process cannot enjoy the full luxury of being neatly organized in the same, time-independent, manner as a corporate assembly line.

perspective. This perspective has been divided into three major causes of personal frustration. These causes are an inadequate level of personal knowledge, lack of battlefield damage assessment, and the inability to effect corrective action.

1. Inadequate Level of Personal Knowledge

The average corps staff officer it intelligent, highly motivated and fiercely dedicated. Yet, this admirable array of qualities does not, magically, endow the staff officer with the body of knowledge needed to optimize corps fire support. Two primary factors contribute to the insufficiency of personal knowledge, the first of which is limited exposure to corps level operations.

a. Limited Exposure to Corps

As might be inferred from the relatively few existing corps headquarters, the number of personnel having the opportunity to gain first-hand knowledge of the corps fire support process is extremely limited. Current personnel assignment procedures reduce even further the on-the-job training experience. An army officer assigned to a corps headquarters remains in that assignment, typically, twelve to eighteen months. During that time period, the officer might possibly participate in four to six field exercises. The complexities of the corps fire support process cannot be adequately digested in this small number of sporadic experiences. Thus, personnel become frustrated

by the awareness that they are unable to develop a sufficient level of expertise in the field environment. Additionally, each field exercise seems to be substantially different from the one before it so that a cumulative learning process does not occur.

b. Insufficient Experience

The second factor which contributes to personnel having inadequate knowledge of the fire support process is a function of their previous experience. As has been indicated previously, the FAS is the focal point for the fire support process. Since it is here that the selection of the best available fire support means is performed, it would be reasonable to expect that the personnel making the decision have complete knowledge of the critical parameters of each weapon system. This is not always the case, however. While the FAS is made of field artillery officers, even their knowledge of all field artillery systems may be incomplete. The reason for this is similar to the limited opportunity to obtain corps-level experience. Within the normal job assignment pattern of a field artillery officer, it is not likely that he will have total familiarity with <u>all</u> types of weapon systems. For this reason it is entirely possible that no one in the FAS will be fully cognizant of the specific capabilities and limitations of the Lance missile system. While certain parameters such as maximum range are easy to comprehend and apply, other parameters such as firing response times and weapon effects are more

difficult to conceptualize and to apply in a decision making environment. To extend this problem further, the other members of the CTOC are prone to even greater errors of misunderstanding concerning the capabilities of corps fire support weapons. An actual example of the extent to which these errors can impede the corps fire support process occurred during a recent field exercise. At that time, a senior officer in the CTOC insisted that Lance missiles be fired at a moving enemy tank platoon, located by intelligence sources over an hour before the target data was passed to the FAS. In this example, the selection of an indirect-fire, long-range, weapon system for a moving target is inappropriate. The age of the intelligence data, coupled with the response time of the weapon system, eliminates virtually all chance of success.

2. Lack of Battlefield Damage Assessment

Battlefield Damage Assessment (BDA) is the appraisal of the damage inflicted on enemy targets after a friendly weapon system has been utilized. With indirect-fire artillery weapons firing at long ranges, there is usually little information that can be gained concerning what target damage, if any, was achieved. Yet, it is this immediate feedback which is vital to the continuous effort to insure that fire support assets are being effectively allocated. If air assets are utilized to attack targets, it is possible that some BDA will be obtained via photographic means or a

pilot's visual sighting. In a high air defense threat environment like Europe, it is unlikely that even this is available. Lack of BDA is therefore another source of personal frustration, since the FAS members are unable to fully determine the effectiveness of their decisions.

3. Inability to Effect Corrective Action

The sporadic nature of field exercises and high personnel turbulence in the staff sections result in a situation which causes the third type of frustration. That frustration is a feeling of helplessness due to the inability to effect lasting and significant changes in the CTOC organization, relative to the corps fire support process. Corps staff sections in the field typically operate continuously (24 hours per day) in two, twelve-hour shifts. During the conduct of field exercises, the CTOC operates in hurried response to a predetermined exercise scenario. This hectic environment usually leaves little opportunity for concurrent and innovative reorganization of the CTOC, or refinement of established procedures. After the field exercise ends, the return to garrison conditions is usually immediate. As was previously discussed, the garrison environment is not conducive to improvement of the corps fire support process. As a direct result, the CTOC does not mature as an organization. Corrective actions are rarely implemented, and those that are implemented are usually only temporarily effective. Again, personnel turbulence contributes to the existence of this unsatisfactory condition.

V. SOLVING THE CORPS FIRE SUPPORT ENIGMA

> Why Ideas are Killed: Man is so constituted as to see what is wrong with a new thing ... not what is right. To verify this, you have but to submit a new idea to a committee. They will obliterate ninety per cent of rightness for the sake of ten per cent of wrongness. The possibilities that a new idea opens up are not visualized because not one man in a thousand has imagination.
>
> Charles F. Kettering
> 1876-1958

Increasing the effectiveness of the corps fire support process assumes that there is both room for improvements and a valid need to make those improvements. From the previous chapters, the basis for believing that each of these conditions exist should be firmly established. Several aspects of this basis were the reality of the Soviet threat, the unsuccessful evolution of technological advances, the fluctuating parameters of the CTOC environment and the conflicting interrelationships in the fire support process. It is not intended that the corps fire support process be singled out because it is the only portion of army operations that could be improved. Certainly, there are numerous enhancement possibilities in any large-scale, dynamic organization. Corps fire support is, however, the critical process in corps operations. War, in its most simple form, is a matter of locating your enemy and

destroying his forces. Effective fire support encompasses the full spectrum of these actions.

Proposed solutions or improvements to corps fire support are offered in this chapter. It should be understood that these solutions have been developed without undue concern for political, geographical or bureaucratic constraints which might be asserted as prohibiting their adoption. To do so otherwise would be to limit the imagination and, thus, be guilty of Charles Kettering's premise. Additionally, it is not expected that these proposed solutions will be universally accepted. Dr. Henry Kissinger has stated that, "Decision making can grow so complex that the process of producing a bureaucratic consensus may overshadow the purpose of the effort" [Ref 28, p. 19]. It can only be hoped that the U.S. civilian and military bureaucratic structure can focus on the national defense effort, before the Soviet threat becomes a reality.

A. TOTAL SYSTEMS APPROACH

The proliferation of automatic data processing (ADP) technology in the last two decades has led to widespread attempts to integrate these advances into existing organizational structures. The extent of success of these endeavors in the commercial sector, as well as military C^3I applications, has been much less than expected. This condition has precipitated a deluge of research in the field

of management science such as management information system theory, general systems theory, organizational theory and contingency theory [Ref 29, p.V]. Theories, being speculative by nature, will not provide exacting steps by which the link between ADP technology and organizational results can be forged. Theories are useful, however, in providing insight and provoking debate in the problem area. Yet, continual theorizing without perceptible results is merely academic exercise. In the corps fire support enigma, what are needed are concrete and viable results. It is clear that results cannot be obtained without some explicit modus operandi. One method that can be utilized is a total systems approach.

A total systems approach, proposed in 1968 by Young, asserted that, "organizations should be designed around the technology; technology should not be forced to fit an existing structure" [Ref 30, p. 49]. Since 1968, however, the pace of technological research has disproportionately outdistanced its tangible applications. Consequently, a lengthy defense resource acquisition process can result in fielding equipment measurably behind the state-of-the-art. TACFIRE, for example, has already been cited as being based on technology that is ten to fifteen years old. One major reason for this type occurrence is that design specifications, once declared in procurement contracts, become legal and fiscal constraints. As a result, the equipment purchased by defense outlays tends to be based on past

technology, rather than current technology. The lengthy procurement process often counteracts efforts to take advantage of new technology, needed in the defense establishment.

In consideration of these factors, it is clear that organizations cannot be designed around technology. Conversely, technology cannot be designed around the organization. The reason for this is that the parameters of the CTOC organization are extremely numerous and constantly changing. In a similar situation in the civilian sector, noted by Orkins and Weiss, it was concluded that, "... it is not possible to achieve permanent problem definition, and, as a result, there can be no permanent solution" [Ref 31, p. 419]. What, then, is the solution?

The solution, it would seem, must be a total systems approach that recognizes constant technological and organizational changes as being typical, not atypical, of a complex organization such as the CTOC. These two types of changes are clearly not dependent on one another. Thus, the importance of conscientiously, and explicitly, defining their roles in the enhancement efforts of the corps fire support process is revealed. Additionally, the dimension of time must be considered in the determination of the alternative improvements selected for implementation. One final aspect that must be addressed in this approach is the delineation of its scope.

The scope, or area encompassed, of Young's total system approach equated to the organization being considered. Chapter IV was intentionally divided into systemic, organizational and operational parts to aid in the definition of scope. It should be clear that the CTOC, although defined as an organization, is not the "organization" in the context of the total system approach. The total systems approach must be applied to an area surrounding all three parts to effectively resolve the corps fire support enigma. Figure 7 portrays the total systems approach in this setting.

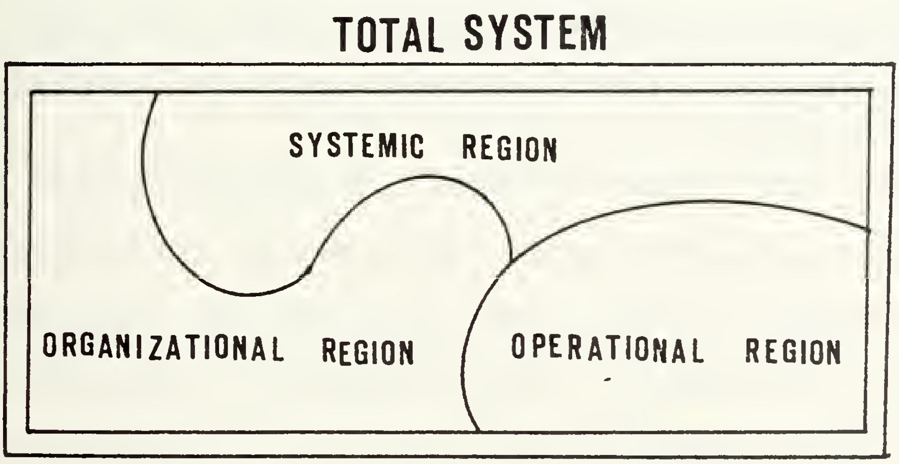

Figure 7. The Total Systems Approach

Supportive of the total systems approach has been the April, 1979, establishment of the Army Force Modernization Coordination Office (AFMCO) in the Office of the Chief of Staff, Army. As its name implies, AFMCO is the staff focal point for coordinating changes in the realm of force

modernization. Its inception is both timely and significant. According to the current Chief of AFMCO, Major-General Richard D. Lawrence, its missions include the following:

1. Monitor all material systems under development and identify those requiring more intensive management.

2. Identify and assess collective problems of force modernization, manage by exception, recommend solutions.

3. Ensure that major commands receive timely data through channels to support fielding.

4. Review plans, studies and actions which involve force modernization and fielding.

5. Identify fielding problems, integrate and coordinate and assume problem resolution.

6. Task Army staff and major commands as required.

7. Maintain fielding overview of selected material. [Ref 32, p. 26]

As might be conjectured, the extent to which these missions are fulfilled will indicate the overall success of AFMCO. Since AFMCO is a coordinating office, not an operating agency, its staff is extremely small. Having only ten, field-grade officers and three civilian administrators besides the chief, AFMCO has limited capability to resolve the wide range of problems indicated in Chapter IV. Yet, it is these types of problems which could effectively obstruct the attainment of AFMCO's missions. In apparent recognition of this limitation, Major-General Lawrence has indicated that, "during the formative period of AFMCO organization, attention will be paid to the type and number of aids to

responsive, incisive management decisions on modernization" [Ref 32, p. 28]. Nevertheless, AFMCO's cognizance of the general nature of the aids needed will, probably, not result in detailed dissolution of the corps fire support enigma.

B. THE FIRE-DECISION SUPPORT SYSTEM

Taking a total systems approach to the solution of the corps fire support enigma establishes the needed framework within which to work, but fails to specify what, exactly, is being sought. To aid in this endeavor, the concept of decision support systems should be applied to the corps fire support process.

The concept of decision support systems (DSS) has evolved in the commercial sector during the last five to ten years. Basically, DSS supports manager decision making by utilizing ADP technology to perform sensitivity analysis of the decision parameters. It has been a logical outgrowth of the management information systems (MIS). While a MIS also utilizes ADP technology, its final product tends to be modest in comparison with the goals of a DSS. MIS, in general, provides the manager with pertinent information displayed to ease the task of decision making. Its focus is therefore limited in the sense that its output is actually a basic input to the manager. The DSS approach focuses on the important decisions of the organization concerned. Thus, its scope includes that of a MIS and the managerial decision making process.

The corps fire support process is, in every respect, a perfect candidate for a DSS approach. According to McCosh and Scott Morton, [Ref 33, p. 39] there are, at least seven criteria which can be applied to determine if a particular problem area is suitable for a DSS. These criteria are listed below in Table XII.

Table XII

Criteria for Applicability of a Decision Support System

1. The problem must be of central importance to a manager. It must be a key decision.
2. Large data base present.
3. High volume of data manipulation.
4. Analysis can be performed in discrete stages.
5. Large amount of judgemental decision-making.
6. Complex interrelationships.
7. Numerous communication interfaces required between sub-elements of the system.

One criteria which could be added to Table XII which is applicable to the corps fire support process, but often ignored, is a critical need for a timely decision. Indeed, a military-oriented DSS may be many times more sensitive to this criteria that a commercial-oriented DSS due to the fleeting nature of targets and, the life and death consequences of the mismanagement of combat resources.

Thus, the goal for the total systems approach ought to be the attainment of a viable fire-decision support system (FDSS). It must span the entire corps fire support, shown in Figure 2. The FAS, since it is the focal point, should monitor the FDSS and adjust its decision making criteria as the combat situation changes. The remaining portion of this chapter proposes possible solutions to the corps fire support enigma. Its format is similar to Chapter IV, again to facilitate the mental superimposition of material. The suggestions are referred to as "solution spaces" to maintain a mental frame of reference. However, they should be considered segments of a continuum of solutions, not discrete answers. The desired goals cannot be achieved by a piecemeal approach. Synergistic effects of the solutions must be gained where possible. The fire-decision support system can be explained only as a totality, not as an arithmetic sum of parts.

C. SYSTEMIC SOLUTION SPACE

The systemic perspective in Chapter IV explained some of the factors, external to the CTOC, which inhibit the advancement of the corps fire support process. From these factors, it may logically be deduced that the development of the CTOC is partially dependent on the productivity and cooperation of the associated, external actors. As might be surmised, a corps commander has limited influence on

these actors. Therefore, corps commanders, understandably, hesitate to expend their constrained time and limited resources in attempting to influence equipment and system developments. This occurs especially if their efforts appear unlikely to increase corps capabilities during their tenure. The natural tendency is to concentrate only on problems that can be solved in the immediate future. Thus, long-range plans and solutions for the corps are relatively low in priority. Conveniently, the belief that a corps commander need not become involved with research, development and acquisition, because organizations such as DARCOM have the responsibility for this effort, seems to be widely held. The question is whether or not this approach is a satisfactory one. A momentary digression may serve to illuminate the issue.

It is often correctly asserted that the 1973 Middle East War demonstrated the importance of combined arms operations in the determination of success on the battlefield. U.S. Army doctrine also emphasizes that maximum combat effectiveness can only be obtained through combined arms teamwork [Ref 23, p. 3-10]. Indeed, the preponderance of the Soviet ground forces are organized into Combined Arms Armies (CAA) [Ref 34, p. 1]. Yet, the combined arms concept is not new. One of Napolean's maxims of war was, "Infantry, cavalry, and artillery can not do without one another ... " [Ref 35, p. 69]. The, seemingly, universal and timeless acceptance of this concept is truely amazing.

It has been stated that combined arms has led to "the fastest, most effective execution of the mission" [Ref 23, p. 3-10]. The basis for this reasoning appears to be that combined arms represent a finely-tuned balance between complementarity and co-ordination. The payoff is enhanced combat power via the synergistic effects of the component systems. Can this battle-proven approach be, in some way, incorporated in the development of a fire decision support system? It is believed that it can!

1. <u>Increasing Corps Involvement</u>

If the total systems approach definition of "organization" is utilized, there can be little doubt about the general course of action needed. According to William T. Morris, the basic problems of organizational design are "how to divide the work of the organization among its members and of how to co-ordinate the activities of the members" [Ref 36, p. 25]. The resolution of these problems lies, according to Morris, somewhere between the two extremes of decentralization and centralization [Ref 36, p. 11].

It seems prudent to shift a greater portion of the research and developmental effort to corps organizations. The CTOC and the expertise level of the personnel that are assigned to it comprise the essential elements of the "battleground" on which many of the C^3I systems will be fielded. As depicted in Table X, geographical dispersion

of the developing agencies and civilian corporations, alone, pose a major problem. As long as the current array of discrepancies exist a national objective of military preparedness, sufficient to meet the communist threat, cannot be attained.

The functional and equipmental dissimilarities between the various types of U.S. corps headquarters indicate that this shift in resources will not be sufficient if it is only performed on one testbed location. The current goal of research, development and acquisition methods is to increase overall efficiency by avoiding duplication of efforts, where possible. What is possible, however, must be a question answered by a meticulous and continuous comparison of the real variants in the CTOC organizational environment. One way in which to achieve the level of understanding and coordination needed would be to establish a single "contact team" that could circulate among the five corps headquarters to keep all corps organizations informed of the efforts of the others. To avoid conflicts with the command authority hierarchy, it would have an advisory role as opposed to a directory role.

Increasing corps involvement is supported by the same rationale used to increase user involvement in the design of management information systems. The advantages of this design approach, as reported by Lucas [Ref 37, p. 83], are the following:

1. The user has "psychological ownership" of the new system.

2. "The user will understand the system and become trained in it more easily."

3. "The user knows what is needed for the application, and, since the user is in control, quality will be defined according to user criteria."

4. "The user interface with the system will be appropriate because the user will have designed it."

It is highly probable that increased corps involvement would, initially, be disfavored by corps commanders. The simple reason for this fact is that they are not staffed to cope with this additional mission. One possible solution to this deficiency would be to augment the corps headquarters with a special staff section working directly under the corps Chief of Staff. The placement of this section under the Chief of Staff is in concert with his responsibilities and, therefore, would be functionally correct.

2. <u>Evolutionary Development</u>

The process by which the organizational equipment and system changes are made, in general, should be evolutionary instead of revolutionary in nature. The decision as to what is considered evolutionary and what is revolutionary must be made at corps level. Evolutionary changes can be thought of as incremental improvements over time. General (USA, Retired) Bruce C. Clarke, who Eisenhower called the greatest trainer of soldiers since Washington's General Von Steuben at Valley Forge, describes this as the "little pluses" method. According to Clarke,

the most effective way to improve a military organization is to "improve gradually every facet of the organization over a period of time ... " [Ref 38, p. 111].

It is recognized that economy of scale solutions in RDT & E processes can result in monetary savings. Yet, this benefit is often more apparent, than real. Again, the decision on when they should be applied must be part of a conscious effort at corps level to attain visible improvements in the corps fire support process. Cost benefits must not be sought at the expense of system effectiveness.

3. Conflict Resolutions

Relational conflicts, such as those existing between corps and division levels, were cited in Chapter IV. Doctrinal or managerial conflicts must be identified during training exercises and commander conferences. Explicit clarification of these issues must be made, recorded and followed. These conflict resolutions, whenever possible, have to be made before actual combat is required.

4. Committed Flexibility

The problems of overmanagement and overcontrol must be conquered by a demonstrated desire to permit the fiscal and operational freedoms needed to accomplish stated objectives. While some constraints are necessary, the controlling mechanism utilized must not be responsible for the failure to attain that which you are trying to achieve.

Committed flexibility may be facilitated, in part, by the evolutionary method since short-range objectives produce discernible results which are easier to fiscally and rationally justify.

D. ORGANIZATIONAL SOLUTION SPACE

Organizational improvements must be obtained through innovative management at corps level. By utilizing the "little pluses" approach, even generic problems may be solved. Time, fiscal and resource constraints will continue to create a situation which has been called a "hostile training environment" [Ref 39, p. 16]. The key to solving this situation is to recognize that the first goal of the army has been specified, by law, in Title 10 of the U.S. code. Its mission is the "... preparation of land forces for the effective prosecution of war ... and organizing, training and equipping for prompt and sustained combat" [Ref 37, p. 16]. Any obstructions to achieving this goal must be eliminated if the maintenance of an Army is to have any meaning at all. There can be no excuses or reasons for failure. As once asserted by General of the Army Douglas MacArthur, There can "... be no substitute for victory!" [Ref 12, p. 564]. In training, as in war, the objective should be clear.

1. Maintain Field Orientation

The garrison versus field conflict may be eased by altering the garrison environment to parallel working relationships that are normally found in the CTOC. This does not mean that the CTOC physical configuration need, necessarily, be constructed identically in garrison. It does mean that every possible similarity in an operational context should be duplicated, if feasible. It is true that garrison duties do not correspond to those performed during a, scenario-driven, field exercise. What can be done, however, is that the percentage of personnel involved in garrison duties can be deliberately forced to a low level. The remaining portion of the personnel must be given the mission, and the time, to resolve field (CTOC) problems. To avoid the tendency to specialize the personnel in the garrison area, periodic rotation of the personnel must be enforced to insure the field expertise is spread throughout the organization.

2. Observe Subordinate Units

Understanding the capabilities of subordinate units means knowing their proficiency and their limitations. The best way to accomplish this is by establishing informal observational visits during their field exercises. This program would also involve division-level staff counterparts establishing liaison visits to the corps staff. To the fullest extent possible, all officer and senior enlisted

men on the corps staff should be involved on a rotational basis. Admittedly, this type of training would be time-consuming and, possibly, expensive. The professional knowledge and personal affiliation which would result, however, could be a significant advantage in effectively utilizing the combat resources in actual conflict.

3. Crosstrain Personnel

Section autonomy and mystique may be the most difficult deficiencies to eliminate. A viable crosstraining program could be the mechanism by which section interface problems can be lessened. The key to success in this endeavor would be to establish the legitimacy of this program by periodically evaluating staff sections' knowledge of the duties and responsibilities of the remaining sections. The evaluation method to be utilized should be tailored by the particular Chief of Staff concerned.

E. OPERATIONAL SOLUTION SPACE

The assertion made in Chapter IV that the current level of expertise of corps staffs is insufficient is likely to evoke emotionalism, if not intense anger. Yet, an unbiased study of this issue may prove to substantiate it. What must be emphasized is that environmental factors have been responsible for this situation and not flagrant incidents of personal disregard. Samuel P. Huntington, in his

writings concerning the military profession, asserts the following:

> The variety of conditions under which violence may be employed and the different forms in which it may be applied form the basis for sub-professional specialization. The larger and more complex the organizations of violence which an officer is capable of directing, and the greater number of situations and conditions under which he can be employed, the higher is his professional competence. The officer who can direct the complex activities of a combined operation involving large-scale sea, air, and land forces is at the top of his vocation.
>
> [Ref 40, p. 7]

The corps staff officer must epitomize these fundamental truths if the corps fire support process is to be viable. Three aids to achieving this greater end are proposed.

1. Planned Corps Professionalism

Current personnel turbulence is the first factor that must be solved. Assignments to a corps headquarters must be recognized as a career enhancing tour of duty. A minimum of three years, tour duration must be required to stabilize the level of staff expertise. Under the Army's dual specialty concept, a major part of the Officer Personnel Management System (OPMS) [Ref 41], the position of "Corps Staff Officer" could be officially recognized as a valid alternate specialty. A key component of professionalism is a specialized core of knowledge. The establishment of this component, by specific design, will avert chance uncertainties which presently pervade this area.

2. Recognition of Feedback

The lack of Battlefield Damage Assessment exemplifies another deficient condition which exists. In this particular case, operational procedures or equipmental innovations could be contrived in an attempt to close time and spatial separations on the battlefield. Allocating targets to weapon systems efficiently does not, in itself, determine success on the battlefield. Similar to the necessity in the commercial sector for periodic financial statements to indicate the success of a profit-oriented corporation, tangible feedback must be obtained and evaluated during the course of battle and not solely at the determination of battle outcome.

3. Result Orientation

Discernible results from changes must, somehow, be obtained on a regular basis. To this end, measures of performance and measures of effectiveness (MOE) must be defined and validated. A measure of performance is a quantification of what a system does. In the case of a weapon system, valid measures of performance might be its maximum range or the number of rounds fired per minute. A measure of effectiveness, however, quantifies what performance is worth in terms of battle outcome. An example of this would be the number of enemy targets destroyed, per unit time. Quite evidently, actual combat results cannot

be determined during peacetime conditions. Thus, "surrogate measures of effectiveness" [Ref 42] must be found, which are attainable. As maintained by Professor James G. Taylor, "Very often failure to choose the appropriate measures of effectiveness can lead to completely wrong conclusions as to preferred alternatives" [Ref 42]. Some form of operational combat model, such as computer simulations or interactive wargames, may be developed to provide explicit results to verify the viability of the corps fire support process. Judgment and experience, however, must also be utilized to obtain a qualitative validation of this process.

VI. CONCLUSIONS AND RECOMMENDATIONS

Though much is taken, much abides; and though
We are not now that strength which in old days
Moved earth and heaven, that which we are, we are-
One equal temper of heroic hearts,
To strive, to seek, to find, and not to yield.

Tennyson (1842)
From "Ulysses"

With the same unconquerable soul displayed by Tennyson's Ulysses, the United States Army must relentlessly pursue the objective of effective corps fire support. The importance of achieving this objective cannot be overstated. It is recognized that optimizing corps fire support will not, alone, determine the outcome of future wars. Yet it is evident that its role is of major significance to success in large-scale, ground combat.

A. BASIC CONCLUSIONS

1. Insufficiency of Corps Fire Support

A realistic appraisal of the effectiveness of corps fire support, and the viability of related developmental efforts, has clearly indicated a condition of insufficiency. It is similarly evident that a relative increase in the Soviet threat, in real or perceived terms, has amplified the significance of this condition. In contrast with the

commercial sector, what is at stake is more than mere financial loss of a corporate enterprise. Instead, human lives and, in the final analysis, our national being are in jeopardy. While the degree of this insufficiency may be inconsequentially debated, the recognition of its existence is adequate to refuse satisfaction with the status quo.

2. Essentiality of a Total Systems Approach

The complexity of the corps fire support enigma established the need for a total systems approach. Table VIII depicts the interfacing of the pertinent factors obstructing effective corps fire support, with the proposed solutions. As noted in the asymmetric distribution of interface connectivity points ("X"), there is not a simple, one-to-one, correspondence between table-entry components. This is indicative of expected "spillover effects" which characterize complicated interrelationships which exist.

As supported by Stephens, "Managers gain new vision and ability to comprehend the true nature of organizations when they think wholistically concerning their total social, economic, technological and political nature. Managers unify organizations' purposes, structures, and relationships through wholistic concepts" [Ref 25, p. 209]. A total systems approach to the corps fire support enigma is a consequence of the acceptance of complexity as a natural state, which needs to be intensively managed. Piecemeal management will not accomplish the desired military state of readiness.

TABLE XIII

Interfacing of Corps Fire Support Components

CONTRIBUTING FACTORS		PROPOSED SOLUTIONS: SYSTEMIC				ORGANIZATIONAL			OPERATIONAL		
		Increasing Corps Involvement	Evolutionary Development	Conflict Resolutions	Committed Flexibility	Maintain Field Orientation	Observe Subordinate Units	Crosstrain Personnel	Planned Corps Professionalism	Recognition of Feedback	Result Orientation
SYSTEMIC	Discontinuity between Developers and Users	X	X								
	Discontinuity due to simultaneous systems design	X	X								
	Discontinuity due to personal or corporate objectives	X			X						
	Corps Nuances	X	X					X			
	Dependency on Time and Scenario	X	X					X			
	Unknowns left to Corps Organization	X	X					X			
	Corps versus Division Interests	X		X			X				
ORGANIZATIONAL	Garrison versus Field Turmoil					X					
	Proximity to Battle					X	X				
	Lack of Common Knowledge							X			
	Lack of a Common Sense of Urgency					X	X	X			
	Section Autonomy					X	X	X			
	Section Mystique					X	X	X			
	Environmental Inconsistency					X	X	X			
OPERATIONAL	Inadequate Level of Personal Knowledge								X		
	Insufficient Job Experience								X		
	Lack of Feedback									X	
	Inability to effect Corrective Actions										X

3. Necessity for a Fire-Decision Support System

The focus of a total system approach to corps fire support must include the establishment of a viable fire-decision support system (FDSS). Without an understandable, and agreed upon, perception of the operational goals being sought, developmental and acquisitional processes tend to be nonproductive in the final analysis. Several rules for successful decision support systems in the commercial sector have been cited by McCosh and Scott Morton [Ref 33, p. 217] and are listed in Table XIV.

Table XIV

Rules for Successful Decision Support Systems

1. Keep it simple.
2. Tackle significant problems.
3. Don't let the computer people design the model.
4. Don't let the operations research staff design the model.
5. The manager who is responsible for the subject should be the person who designs the model.
6. Use the staff people to make the model.
7. Test the model and adjust it.
8. Regard the replacement of models by better ones as evidence of vitality, not of earlier errors. (a corollary of Rule 1)

Factors such as the criticality of time and the limitations of existing weapon systems must be included in the military application of decision support system theory. The only

location where these factors can be adequately considered for a corps fire-decision support system is at the Corps Tactical Operations Center, itself.

4. Requirement for an Implementation Strategy

The most important conclusion to be drawn from this thesis is the absolute necessity for a well-grounded, effectual, implementation strategy. Implementation has been defined by Lucas as "the entire change associated with a new system" [Ref 37, p. 76]. Adoption of an explicit strategy for implementation legitimizes the institution of behavioral and organizational changes during development of a corps fire decision support system. Implementation must also be validated as effectual through continuous evaluation of the effectiveness of corps fire support. Lucas maintains that there is no universal procedure for accomplishing this validation. He suggests, in lieu of complete uncertainty, that one measure of success that might be utilized is the degree of user satisfaction. To augment this judgmental measure, quantitative and qualitative measures must be determined Ref [37, p. 77]. Regardless of the type or the quantity of the changes instituted, incremental improvements in corps fire support must be resolutely accomplished.

B. DISPELLING THE MYTH OF ORIGINALITY

Henry Kissinger once stated that the most frequently asked question of a foreign policy consultant in Washington is, "Have you had any new ideas lately?" [Ref 43, p. 89]. The impetus behind this question, according to Kissinger, was the apparent misconception that "constant originality is the essence of foreign policy" [Ref 43, p. 89]. Kissinger dispels this myth by asserting that, "Most ideas that masquerade as new ideas in Washington have been around for quite a long time" [Ref 43, p. 89]. In a similar fashion, the ideas presented in this thesis are not, necessarily, revolutionary in nature. Yet, an amalgamation of these ideas in a single work is not known to exist. The crucial issue at stake is not whether originality has, or has not, been generated in resolving the corps fire support enigma. Instead, it is simply whether corrective actions needed to solve existing problems, have been successfully implemented. This must be the prevailing notion.

C. RECOMMENDATIONS

The objective of this research effort has been to examine and evaluate the corps fire support process with its expected, technologically-based, enhancements. While motivated by personal experiences in a corps field artillery section, individual bias was, hopefully, not a significant factor in the determination of direction or outcome of the

analysis. As proposed solutions and conclusions were derived, introspection was calculatedly performed to insure their validity. In a similar fashion, specific recommendations have been compiled. These recommendations should not be construed as representing the totality of actions needed to solve the corps fire support enigma. Instead, they are simply representative of types of actions which should assist in the resolution of the corps fire support enigma.

1. Identify the Players

Explicit identification of the major and minor participants in the effort to solve the corps fire support enigma must be performed at the outset. While the Army Force Modernication Coordination Office (AFMCO) will be the staff focal point at Department of the Army level, this organization cannot be expected to be a panacea. The Department of the Army (DA) must establish, in specific terms, the roles to be played by the corps headquarters, the army branch schools and centers, the research and developmental agencies, AFMCO, and the DA staff sections. It must also fix the involvement of organizations outside the immediate sphere of the army, such as sister services and applicable high-technology industries.

2. Apply Organizational Development Theory

Organizational development (OD) theory has primarily evolved over the past twenty-five years. In 1974, the Army

Chief of Staff established an army-wide, derivative of OD theory, designated as the Organizational Effectiveness (OE) Program. While no definitive appraisal of the long-term effectiveness of this effort has been made, its potential for aiding the solution of the corps fire support enigma is present. Friedlander and Brown (1974) have depicted the essence of organizational development, as reproduced in Figure 8 [Ref 44, p. 497].

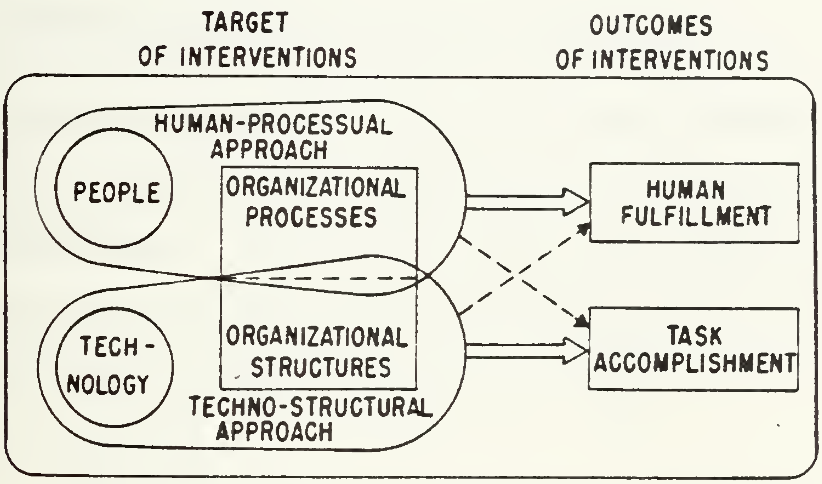

Figure 8. Approaches to Organizational Development

3. <u>Recognize the Sources of Resistance to Change</u>

The natural tendency of both human and organizational entities appears to be a resistance to change. This resistance may stem from internal or external sources. Regardless of where they originate, management throughout the Army must explicitly acknowledge their existence and consciously reduce their effects. Webber [Ref 21, p. 695]

has listed these sources as the following:

1. Inertia of groups and organizations
2. Ignorance of trends
3. Investment in what will become obsolete
4. Preference for Present System
5. Fear of Loss (of security, status, power)
6. Rejection of change source
7. Fear of the unknown

4. <u>Stress the Ideal Climate for Change</u>

The most elaborate plans for organizational change are doomed to failure if a permissive "climate for change" is not maintained. Once again, Webber has provided the groundwork for a generalized description of the essential elements of this climate Ref [21, p. 701] .

a. Openness

There must be an aggressive commitment between all organizations and managers to obtain frank feedback on their performance. Obtaining a viable corps fire support process must transcend organizational and personal vanities.

b. Honesty

It is essential that the major players involved in the resolution of the corps fire support enigma are honest with themselves and other players. Formal safeguard procedures must be instituted to allow and encourage criticism without fear of reprisal.

c. Mutual Respect

"Managers and change agents should not assume that everyone always resists change. Such an explanation tends to be self-fulfilling ... " [Ref 21, p. 703]. Emphasis on this climatic condition should include, when absolutely necessary, the removal from positions of personnel who demonstrate refusal or inability to support the principle.

d. Courage and Commitment

The personnel involved must be convinced that what they and the organization are doing is beneficial, in some sense. The "Hawthorne Effect" [Ref 44, p. 493], derived from a 1924 study, documents the significance that a clear perception of importance by the work force can have on individual and organizational motivation and performances.

5. Establish Effective Linking Mechanisms

The army must effectively bridge the gaps between the major players with some form of "linking mechanisms." One type of linking mechanism has been recently proposed by AFMCO. Called the Army Modernization Information Memorandum (AMIM), this annual, written document will be provided to "material, combat and training developers, the functional system managers, and the commanders in the field" [Ref 32, p. 27]. It will provide detailed information on forty to fifty new systems. Additionally, a summary of more than

one hundred other items will complete the document. While written documents possess some advantages, the complex and transient nature of the corps fire support process, alone, indicates the necessity for additional linking mechanisms. A more positive and effective means to link the major players is the establishment of coordinating teams. The expressed purpose of these fielded teams would be to provide personal coordination on a continuing basis. For example, AFMCO needs the means and the authority to physically visit players, at their installations. Similarly, these players need the capability to conduct liaison visits with each other. Essentially, a one-to-one,"equal footing", close relationship must be effectively established.

6. Augment Organizations Where Necessary

Spontaneous augmentation of organizations should be encouraged when it is apparent that end objectives cannot, otherwise, be obtained. It is recognized that fiscal and manpower constraints have to be reckoned with. Nevertheless prioritization of programs may indicate the sagacity of shifting resources to accomplish the major portion of the army objectives. In the solution proposed in Chapter V of augmenting the corps staff under the Chief of Staff, the redistribution of personnel authorizations from other corps staff positions is preferable to the current situation. The term "management" implies a flexible attitude in the utilization and augmentation of organizational resources.

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